

Essential Physics I

英語で物理学の

エッセンス I

Lecture 1: 18-04-16

Course Basics



ESSENTIAL PHYSICS 1 M 16:30 - 18:00

Instructor: Elizabeth TASKER, office 2-9-11, tasker@astro1.sci.hokudai.ac.jp

TA: Hikari SHIRAKATA, office 2-9-03, shirakata@astro1.sci.hokudai.ac.jp

Textbook: 'Essential University Physics with MasteringPhysics', Richard Wolfson / Pearson, ISBN 978-0321714381

Students must have the 'Mastering Physics' student access code card to complete the homework. The book can be bought from the University COOP (Seikyou) or from amazon.co.jp.

Notices: Any important information about the course will be posted on the course website:

<http://astro3.sci.hokudai.ac.jp/~tasker/teaching/ep1>

Please check this regularly.

Homework

(1) Weekly homework problem sets will be on the 'Mastering Physics' website:
<http://www.masteringphysics.com>.

Course ID: EP12016TASKER
Student ID: Your Hokudai student ID

(2) During the semester, there will also be approximately 3 short news articles to read. Students must identify the main points of the article and write a 3-5 sentence summary.

(3) For the end of the semester, students will write a 250 word summary of a news article of their choice. The news article can be one previously covered in class, or one of their own choosing. This article must be submitted with their summary by 2016/07/25. It counts for 5% of the homework percentage.

Clickers: During each lecture, there will be questions on the concepts being covered. Students will answer these using clickers. This is the attendance grade.

Here, it is more important to try than to get the correct answer! If you achieve more than 60% on the clickers, you will get 100% of the marks.

Course Basics

時間 Times:

Monday 4:30 - 6 pm

(Students are expected to attend all classes)

Instructor:

Elizabeth TASKER

tasker@astro1.sci.hokudai.ac.jp

T.A.:

Hikari SHIRAKATA

shirakata@astro1.sci.hokudai.ac.jp

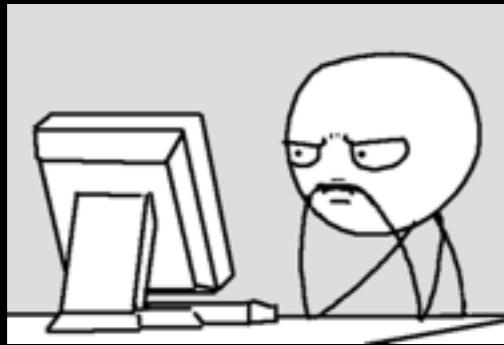
Problems?

Email me and we can arrange a time to meet!

Course Basics

Class website

News



Check regularly!

Lecture slides



Essential Physics I

This webpage has copies of the slides used in each lecture. Any problems, please email the instructor at [tasker\(at\)astro1.sci.hokudai.ac.jp](mailto:tasker@astro1.sci.hokudai.ac.jp) or TA [yusuke\(at\)astro1.sci.hokudai.ac.jp](mailto:yusuke@astro1.sci.hokudai.ac.jp).

News

[11-07-2012] 250 word essay on a physics news topic of your choice due 23-07-2012. Final exam also on 23-07-2012. **Remember your calculator!**

[08-06-2012] Please remember to log onto www.masteringphysics.com and complete the exercise there (Q1 on homework sheet)

The textbook, "Essential University Physics" by Richard Wolfson / Pearson (ISBN 9780321761958) is now available from the COOP/SEIKYOU! You will need a copy to complete the homeworks.

[07-05-2012] Please remember to email me this week so I have your email address.

Slides

Lecture 1: [course summary](#)

Lecture 2: [units & motion in 1D](#)
[[Week 2 homework sheet](#)]

Lecture 3: [motion in 2D and 3D](#)
[[Week 3 homework sheet](#)]

Lecture 4: [circular motion and Newton's Laws](#)
[[Week 4 homework sheet](#)]

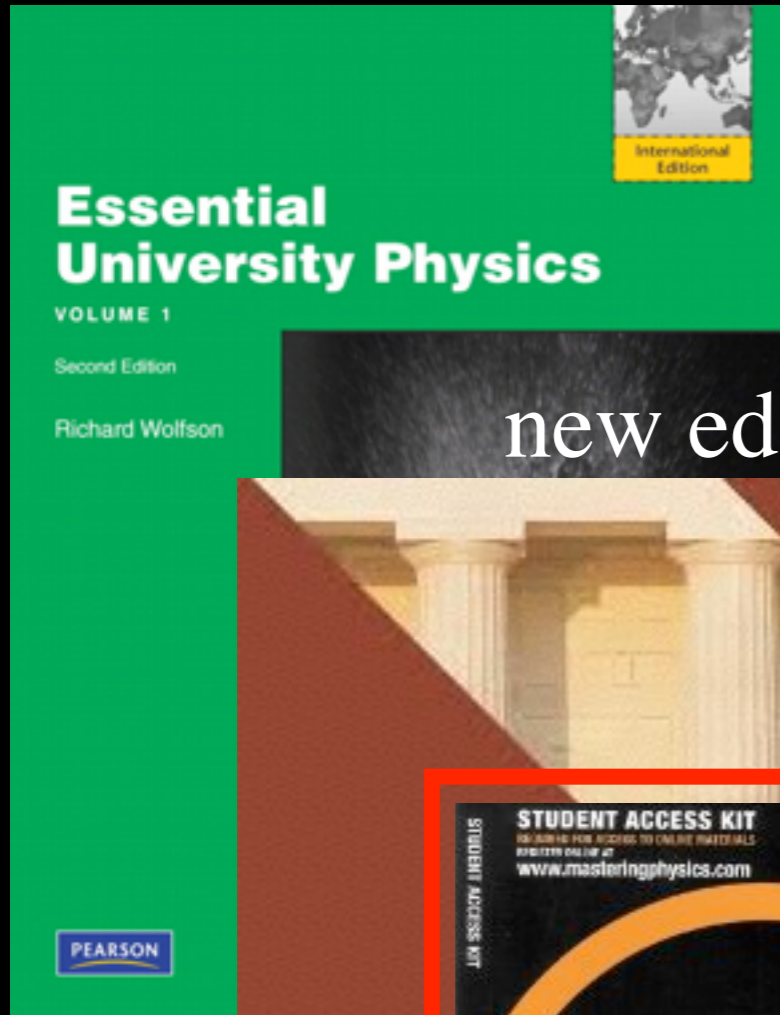
Lecture 5: [relative velocity \(#2\) and forces](#)
[[Week 5 homework sheet](#)]

Lecture 6: [friction, springs and drag forces](#)

<http://astro3.sci.hokudai.ac.jp/~tasker/teaching/ep1>

Course Basics

old edition



new edition

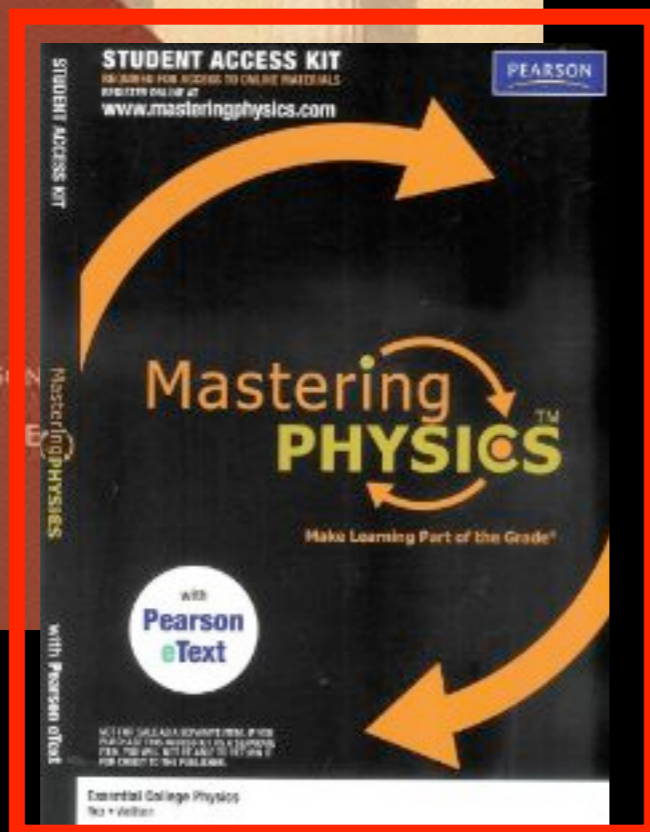


教科書 Textbook:

“Essential University Physics”

Richard Wolfson / Pearson

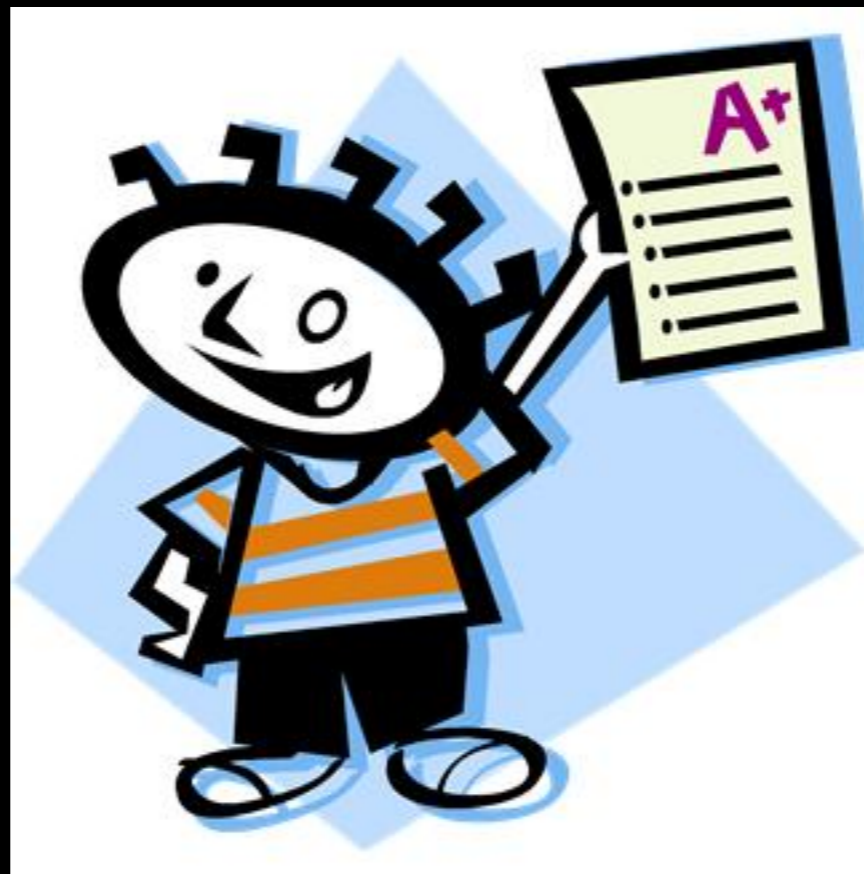
with “Mastering Physics”
student access code card



very important!

Course Assessment

Grades



Course Assessment

Homework 40 % (Essay = 5%)

Attendance / clickers 20 %

Final test 40 %

Total 100 %

Pass > 60 %

Course Assessment

Homework:

35%

Weekly problem set on the 'Mastering Physics' webpage

Due Monday 4:30 pm every week.

Short (3-5 sentences) summary of science article.

~3 in semester

Due Monday 4:30 pm 1 week later.

5%

250 word essay on a science article.

Due July 25th 2016

Course Assessment

Homework 40 % (Essay = 5%)

Attendance / clickers 20 %

Final test 40 %

Total 100 %

Pass > 60 %

Course Assessment

Clickers



clicker > 60 %

+

< 3 lectures missed



full 20 %

for 'Attendance/clickers'

.... except....!

Course Assessment



Please
do not
sleep
in class!

If you sleep, you will be
considered absent

3+ absences = fail



Course Assessment

Homework 40 % (Essay = 5%)

Attendance / clickers 20 %

Final test 40 %

Total 100 %

Pass > 60 %

Course Assessment

Final exam:

10 multiple choice questions

(A)

(B)

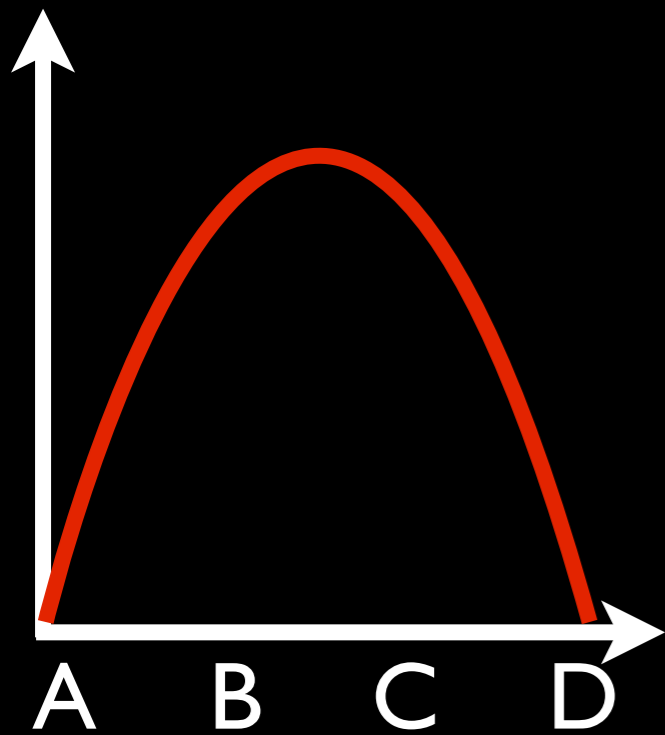
(C)

(D)



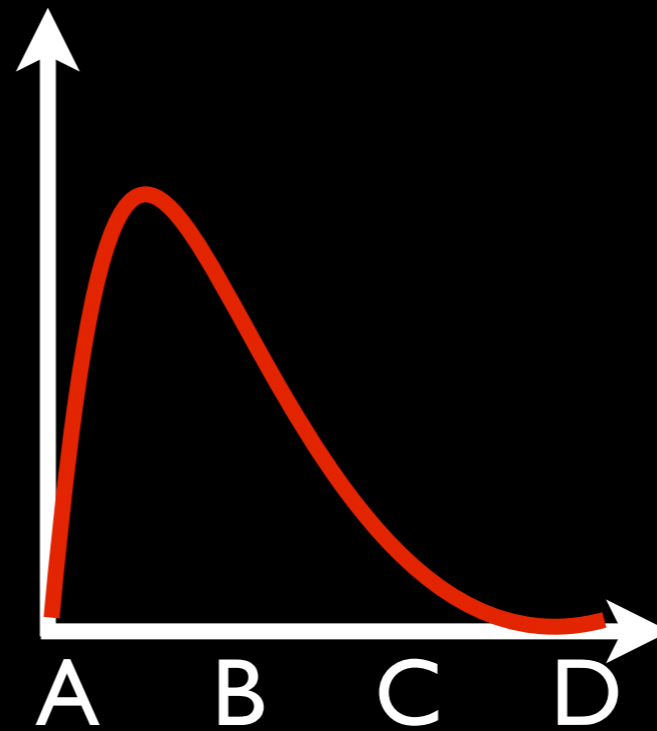
calculator and dictionary OK!

Course Assessment



Relative marking

Fixed % = A

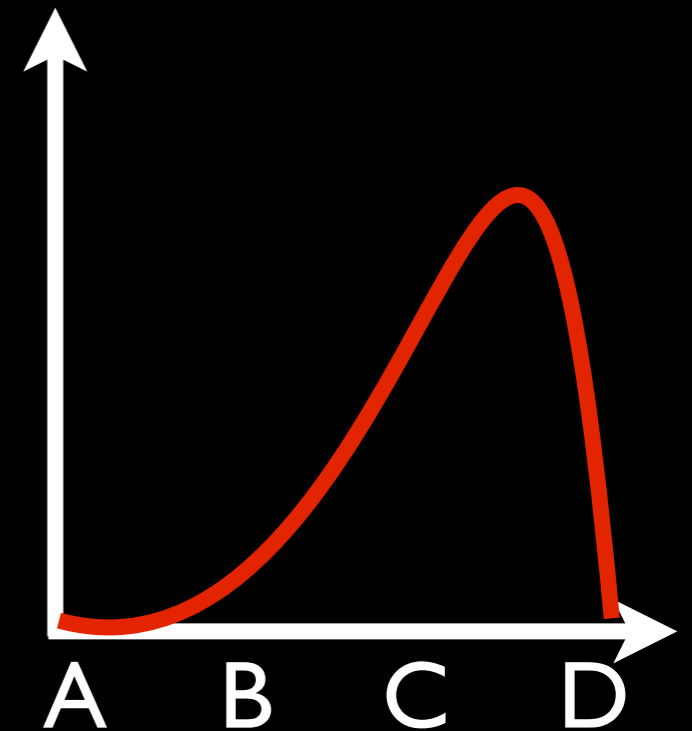


Absolute marking

Every student CAN get an A

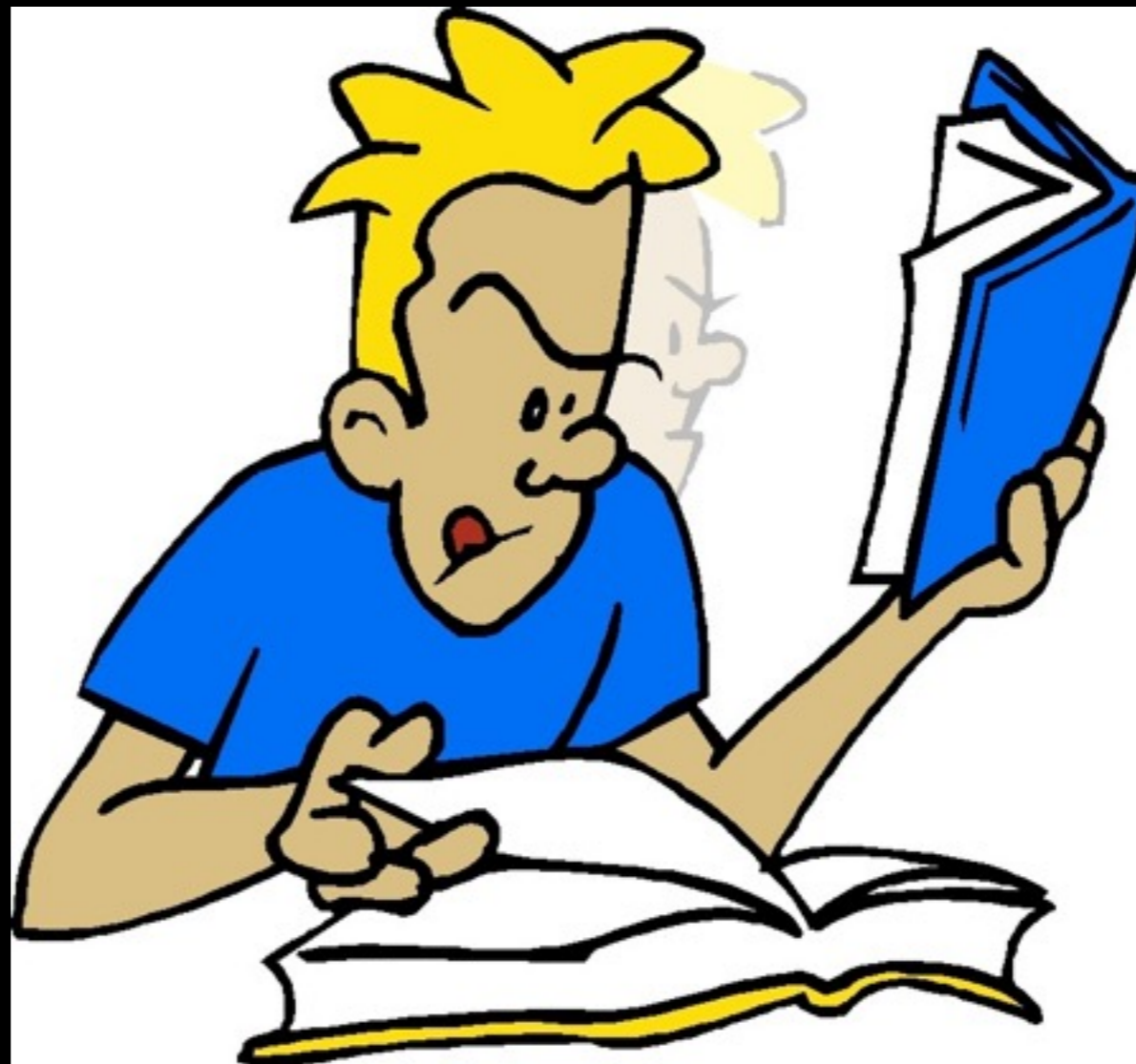
but...

Every student CAN get a D



Online Homework

How to do the 'Mastering Physics' homework



Online Homework

Homework: <http://www.masteringphysics.com>

1 assignment / week

PEARSON

ALWAYS LEARN

MasteringPhysics™

Exciting changes are coming Summer 2015! See what's new >

BREAKTHROUGH

To improving results

Our goal is to help every student succeed. We're working with educators and institutions to improve results for students everywhere. [Learn more >](#)

EDUCATORS & ADMINISTRATORS

- Features
- Get Trained
- Support

STUDENTS >

- Get Registered
- Support
- More...

Sign In

Already registered? Sign in with your Pearson account.

SIGN IN

[Forgot username or password?](#)

Register Now

Need access? Start here!

STUDENT

EDUCATOR



All homework assessments will be here!

Online Homework

PEARSON

ALWAYS LEARNING

MasteringPhysics®

 SIGN IN  REGISTER

BREAKTHROUGH

To improving results



STUDENTS

Get Registered

Titles Available

Features

Support

Get Involved

About Mastering

Do you have these 2 things?

Email

You'll get some important emails from your instructor at this address.

Access code or credit card

You can buy an access code packaged with your textbook or as a standalone access code kit. Or you can buy instant access with a credit card or PayPal account.

OK! Select your location

In US or Canada >

Outside US and Canada >



Online Homework

PEARSON

ALWAYS LEARNING

Register for MasteringPhysics Outside U.S. and Canada

Do you have an access code?

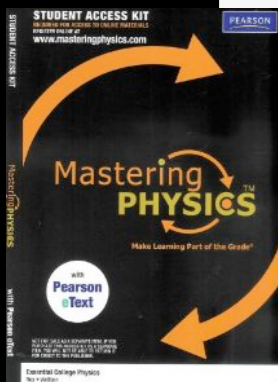
An access code may have been included with your textbook or in a Student Access Card/Kit available from your campus bookstore.

Your access code may look like this:

SIMPLE-FRILL-TONLE-WEIRS-CHOIR-FLEES

If you do not have an access code, you can buy access with a credit card or PayPal account.

- Yes, I have an access code
 No, I need to buy access



Online Homework

PEARSON

License Agreement and Privacy Policy [Help ?](#)

By registering to use a Pearson Education online learning system, I certify that I have read and agree to the **Pearson License Agreement** and the **Pearson Privacy Policy**.

I understand that my personal information may be stored in and/or accessed from jurisdictions outside of my resident country. I consent to this storage and/or access.

The personal information that I use with a Pearson Education online learning system can include my name and contact information, my answers to questions that are part of the course, my marks on tests or other course requirements, and any comments about me made by my instructor.

Privacy Policy [?](#)

Pearson Education Privacy Statement

Pearson Education ("Pearson") recognizes the importance of protecting the privacy of Personally Identifiable Information about you as a user of our online learning applications, websites and educational evaluation tools ("applications"). Follows is an overview of Pearson's Privacy Policy which is wholly contained within the [Pearson End-User License and Privacy Agreement](#) to which end users consent when registering for a Pearson application.

License Agreement [?](#)

Pearson Education End User License Agreement and Privacy Policy

These terms constitute an agreement between You and Pearson Education, Inc, and its direct and indirect affiliates ("Pearson"). Access or use of the website and/or service for which You seek registration constitutes acceptance of this Agreement. If You do not agree to abide by the terms and conditions of this Agreement, please do not register for or otherwise access or use this Website.

Pearson may change any of the terms in this Agreement at any time. Changes will become effective upon



Online Homework

PEARSON Steps to Register

Access Information Account Information Confirmation & Summary

Access Information * Fields are required [Video Tutorial](#) [Help](#) ?

Do you have a Pearson Education account? ?

Yes

No

[Not sure if you have an account?](#)

Access Code ?

Enter your access code.

* Access Code

- - - - -

[Switch to a single box for pasting your access code](#)

Example
SIMPLE-FRILL-TONLE-WEIRS-CHOIR-FLEES

Copyright Pearson Education, 1997-2014
[Customer Technical Support](#) | [Privacy Policy](#) | [License Agreement](#)

Online Homework

PEARSON Steps to Register

Access Information Account Information Confirmation & Summary

Access Information

* Fields are required [Video Tutorial](#) [Help](#) ?

Do you have a Pearson Education account? ?

Yes

No

*** Create a Login Name**

It is recommended that you use your email address. It must be at least four characters. [See acceptable characters.](#)

Create a login name and password. Choose something that is easy to remember.

*** Create a Password**

Strength: **Good**

Create a password. It must be at least 8 characters with at least one letter and one number. [See acceptable characters.](#)

Your password cannot be the same as your login name.

*** Re-type your Password**

Not Sure

Access Code ?

Enter your access code.

*** Access Code**

- - - - -

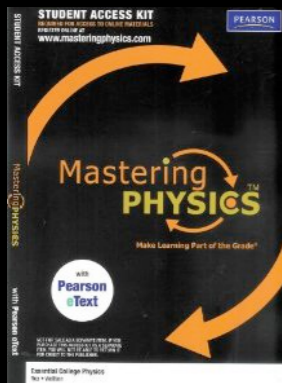
[Switch to a single box for pasting your access code](#)

Example
SIMPLE-FRILL-TONLE-WEIRS-CHOIR-FLEES

email

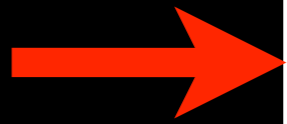


choose
password

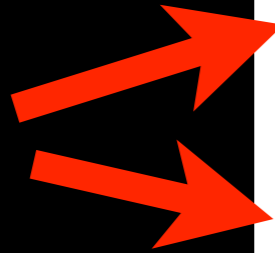


Online Homework

name



email



Use email that
you check!

Sometimes, I may
contact you on this
email.

Account Information

MasteringPhysics for Wolfson, Essential University Physics, 2e- Bundled with eText

Personal Information

* First Name Elizabeth * Last Name Tasker

* Email Address tasker@astro.sci.hokudai.ac.jp

Enter a valid email address. [See acceptable characters.](#)
[Don't have an email address?](#)

* Re-type Your Email Address tasker@astro.sci.hokudai.ac.jp

School Location

* School Country Japan

* School Name Other

Select the name of your school from the list. If your school is not listed, select "Other" at the bottom of the list.

* Other School Name Hokkaido University

* School City Sapporo

Security Question

If you contact us, we will ask you this question to confirm your identity.

Online Homework

Account Information

MasteringPhysics for Wolfson, Essential University Physics, 2e- Bundled with eText

Personal Information

* First Name Elizabeth * Last Name Tasker

* Email Address tasker@astro.sci.hokudai.ac.jp

Enter a valid email address. [See acceptable characters.](#)
[Don't have an email address?](#)

* Re-type Your Email Address tasker@astro.sci.hokudai.ac.jp

School Location

* School Country Japan

* School Name Other

Select the name of your school from the list. If your school is not listed, select "Other" at the bottom of the list.

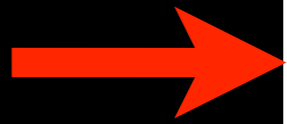
* Other School Name Hokkaido University

* School City Sapporo

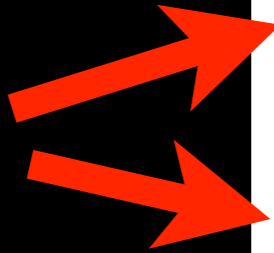
Security Question

If you contact us, we will ask you this question to confirm your identity.

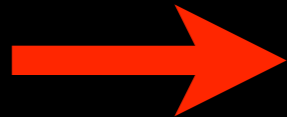
name



email



Japan



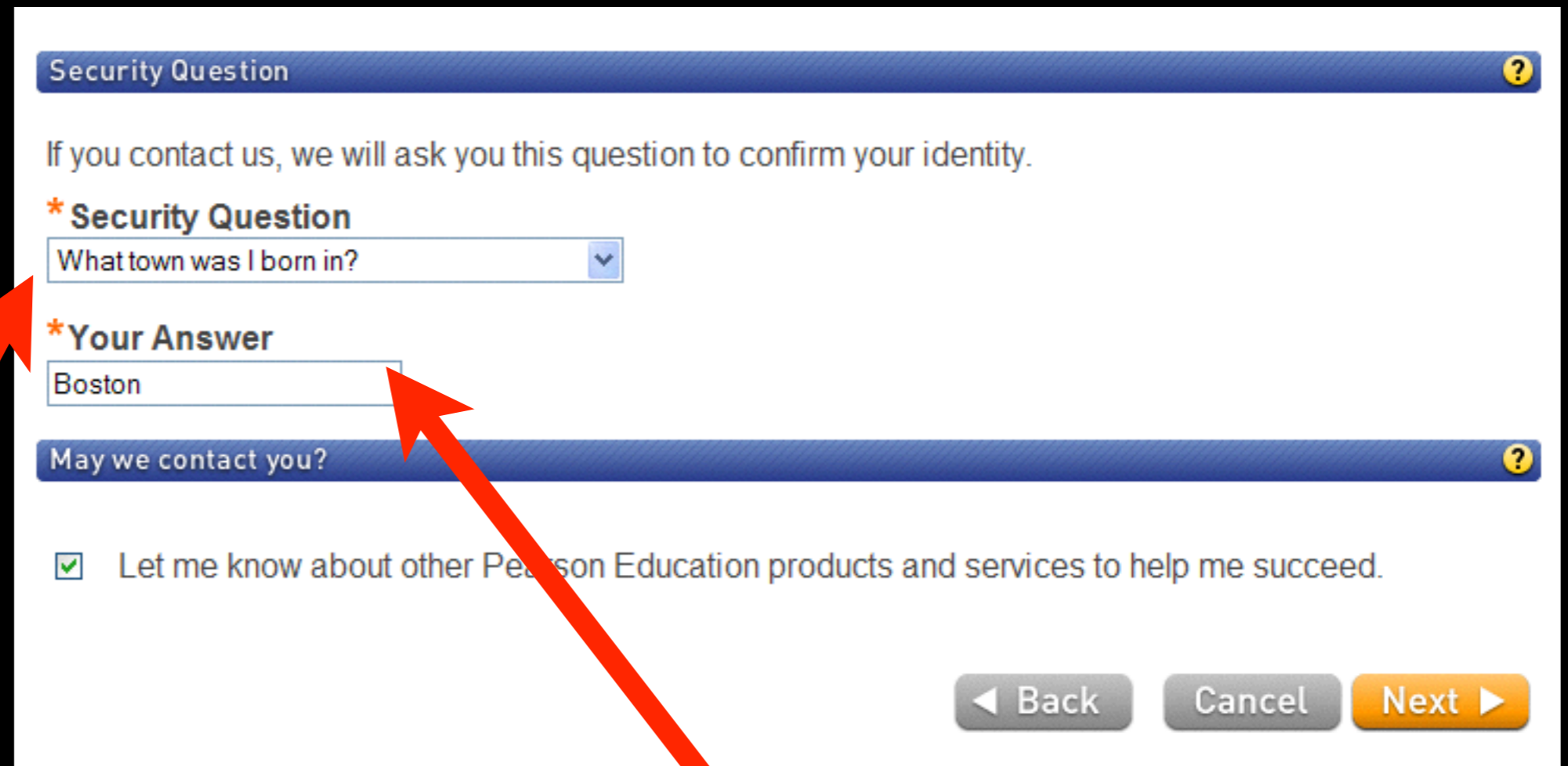
Other



Hokkaido
University



Online Homework



The screenshot shows a web form titled "Security Question" with a help icon. Below the title is the instruction: "If you contact us, we will ask you this question to confirm your identity." The form contains two main sections: "* Security Question" with a dropdown menu showing "What town was I born in?" and "* Your Answer" with a text input field containing "Boston". Below these is a section titled "May we contact you?" with a checked checkbox and the text "Let me know about other Pearson Education products and services to help me succeed." At the bottom right are three buttons: "Back", "Cancel", and "Next". Two red arrows originate from the bottom left: one points to the "What town was I born in?" dropdown, and the other points to the "Boston" text input field.

Security question
(if you lose password)

your answer

e.g. What town was I born in?

Mother's maiden (family name before marriage) name?

Online Homework

PEARSON Steps to Register

✓ Access Information ✓ Account Information ● Confirmation & Summary

Confirmation & Summary Print This Page

You have subscribed to a Pearson Education online product. Please [print this page](#) as your receipt. You will also receive a confirmation email for your records.

You now have access to... ?

MasteringPhysics

Log In Now ▶

If you need to review or edit your account information, visit your [Account Summary](#) page.

Role: Student	Account ID: 25761912
Expiration Date: Jan 1, 2011	Order ID: 48535029
Section or Module: MasteringPhysics	Login Name: physicsstudent1234

About Your Transaction ?

If you have any problems logging into or using this site, please contact [Customer Technical Support](#). If you need to review or edit your account information, visit your [Account Summary](#) page.

Transaction Date: Thu Jul 01 13:37:39 EDT 2010
Order ID: 48535029
Email Address: sara.owen@pearson.com

Online Homework

Join course:

MasteringPHYSICS

Welcome to MasteringPhysics

Join Your Online Course

Did you receive a Course ID from your instructor?

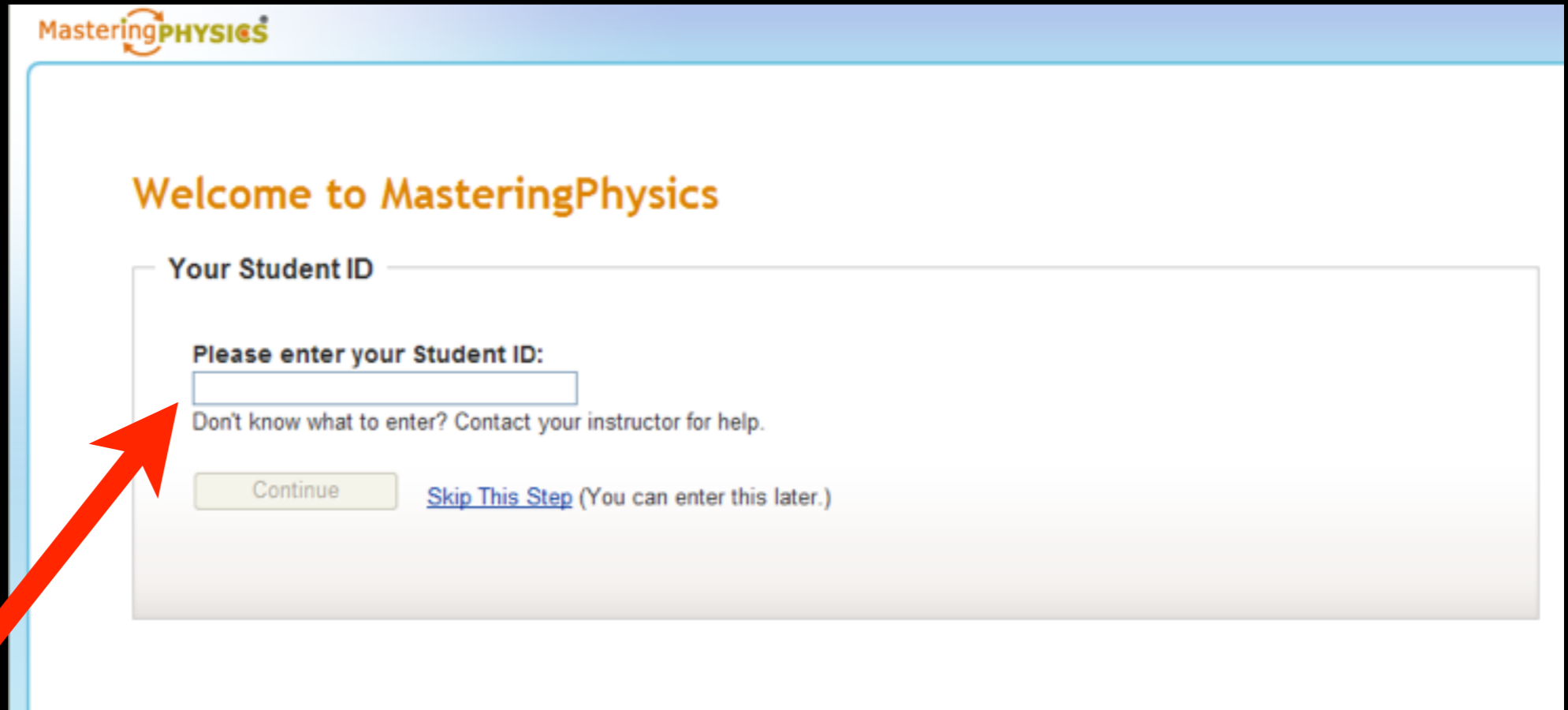
Yes No

[What's a Course ID?](#)

Please enter the Course ID provided by your instructor:

Course ID: EP12016TASKER

Online Homework



MasteringPHYSICS

Welcome to MasteringPhysics

Your Student ID

Please enter your Student ID:

Don't know what to enter? Contact your instructor for help.

[Skip This Step](#) (You can enter this later.)

Student ID: Hokudai Student ID
e.g. 02122000

Online Homework

CONGRATULATIONS!




You are registered with [masteringphysics.com](https://www.masteringphysics.com)

Online Homework

PEARSON

ALWAYS LEARNING

MasteringPhysics™

 Exciting changes are coming Summer 2015! [See what's new >](#)

BREAKTHROUGH

To improving results



Our goal is to help every student succeed. We're working with educators and institutions to improve results for students everywhere. [Learn more >](#)

**EDUCATORS &
ADMINISTRATORS**

Features
Get Trained
Support

STUDENTS >

Get Registered
Support
More...

Sign In

Already registered? Sign in with your Pearson account.

 **SIGN IN**

[Forgot username or password?](#)

Register Now

Need access? Start here!

 **STUDENT**

All homework assessments will be here!

Online Homework

PEARSON

ALWAYS LEARNING

MasteringPhysics®

Sign In

Already registered? Sign in with your Pearson account.

Username

Password



email



password



[Forgot your username or password?](#)

New to MasteringPhysics? Visit our home page to register!

All homework
assessments will
be here!

Online Homework

MasteringPhysics® Signed in as [Elizabeth Tasker](#) | [Help](#) | [Sign Out](#)

Essential Physics I / 英語で学&#x...
[My Courses](#) | Course ID: EP12014TASKER | Course Ends: 08/11/14

[Course Home](#) [Assignments](#) [Scores](#)

Announcements

SUBJECT	DATE POSTED
Welcome! NEW	04/14/14 at 01:13pm

Showing 1 of 1 - [View All Announcements](#)

Course Materials

Get documents and other files posted by your instructor.

- [View Documents](#)
- [View Lectures](#)

Learn More

- [Getting Started](#)
- [How-To Video Tours](#)
- [FAQs](#)
- [Five Ways to Improve Your Grade](#)
- [Tutoring Services](#)

Course Calendar

April 2014

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
30	31	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28 Introduction...	29	30	1	2	3
4	5	6	7	8	9	10

[View All Assignments](#)

news



Online Homework

MasteringPhysics® Signed in as Elizabeth Tasker | Help | Sign Out

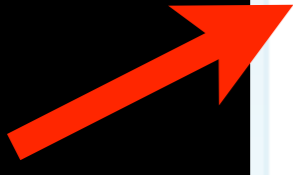
Welcome! Print | Help | Close X

Welcome to MasteringPhysics: all homework for Essential Physics I will be here.

Each week, there will be a new homework assignment. Each assignment will be due the following Monday at 4:30 pm (start of next week's lecture).

Please check here and on the webpage: <http://astro3.sci.hokudai.ac.jp/~tasker/teaching/ep1> for any announcements.

news



Online Homework

MasteringPhysics® Signed in as [Elizabeth Tasker](#) | [Help](#) | [Sign Out](#)

Essential Physics I / 英語で学#x...

[My Courses](#) | Course ID: EP12014TASKER | Course Ends: 08/11/14

[Course Home](#) **[Assignments](#)** [Scores](#)

Announcements

SUBJECT	DATE POSTED
Welcome! NEW	04/14/14 at 01:13pm

Showing 1 of 1 - [View All Announcements](#)

Course Materials

Get documents and other files posted by your instructor.

- [View Documents](#)
- [View Lectures](#)

Learn More

- [Getting Started](#)
- [How-To Video Tours](#)
- [FAQs](#)
- [Five Ways to Improve Your Grade](#)
- [Tutoring Services](#)

Course Calendar

April 2014

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
30	31	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28 Introduction...	29	30	1	2	3
4	5	6	7	8	9	10

[View All Assignments](#)

Homework

Online Homework

MasteringPhysics®

Signed in as [Elizabeth Tasker](#) | [Help](#) | [Sign Out](#)

Essential Physics I / 英語で学&#x...

[My Courses](#) ▾ | Course ID: EP12014TASKER | Course Ends: 08/11/14

[Course Home](#)

[Assignments](#)

[Scores](#)

Essential University Physics, 10th Edition
Wolfson

Assignments

TITLE	DUE DATE/TIME	ACTIONS
Introduction to MasteringPhysics	04/28/14 at 12:00pm	Print View

PEARSON

Copyright © 2014 Pearson. All rights reserved.
[Legal Notice](#) | [Privacy Policy](#) | [Permissions](#) | [Support](#)

This week's homework

Due date: 5/02

(2 weeks because
textbook purchase
needed)

Online Homework

MasteringPhysics: Introduction to MasteringPhysics
session.masteringphysics.com/myct/assignment?assignmentID=2848941

Essential Physics I / 英語で学ぶ物理学のエッセンス I Signed in as Elizabeth Tasker | Help | Close

Introduction to MasteringPhysics Resources

Introduction to MasteringPhysics

Due: 12:00pm on Monday, April 28, 2014

To understand how points are awarded, read the [Grading Policy](#) for this assignment.

A Message from Your Instructor:
The purpose of the following exercises is to familiarize you with the system you will be using for the rest of your course. These exercises are not intended to teach or test your knowledge of any specific subject material. Therefore, you will not be penalized for using hints or submitting incorrect answers.

Welcome! is for 1 point(s) (full credit) Incomplete
Introduction to Numeric Answers is for 1 point(s) (full credit) Incomplete
Introduction to Numeric Answers with Units is for 1 point(s) (full credit) Incomplete
Introduction to Significant Figures is for 1 point(s) (full credit) Incomplete
Introduction to Symbolic Answers is for 1 point(s) (full credit) Incomplete
Introduction to Sorting Questions is for 1 point(s) (full credit) Incomplete
Introduction to Ranking Questions is for 1 point(s) (full credit) Incomplete
Introduction to Graphing Questions is for 1 point(s) (full credit) Incomplete
Introduction to Vector Drawing Questions is for 1 point(s) (full credit) Incomplete
Reviewing the Fundamentals is for 1 point(s) (full credit) Incomplete

Score Summary:
Your score on this assignment is 0.0%

Questions



Online Homework

MasteringPHYSICS

Logged in as Chris Pearson | Help | Log Out


Welcome! Resources Help Close X

[Return to Introduction to MasteringPhysics](#) Previous 1 of 8 Next

Welcome! Chris Pearson

Mastering presents homework items assigned by your instructor and *works with you* to answer them. Homework items typically have an introduction, possibly figures, and one or more parts for you to answer.

Part A **Part B**



Type of help offered

- Mastering tells you immediately whether or not your answers are correct. Usually, you will have multiple chances to arrive at the correct answer. Your instructor will determine how many tries you have available.
- In many items, hints are available to help you if you get stuck. If you don't need the hints to solve the problem, you can still use them for review later on.
- If you submit an incorrect answer, Mastering often responds with specific, helpful feedback.
- Mastering is forgiving of many typos and formatting mistakes. If it can't figure out what you entered, it will let you know and give you another chance.

These exercises were chosen specifically to lead you through the key features of Mastering and are not intended to test your knowledge of any specific subject material. Therefore, on this item you will not be penalized for using hints and submitting incorrect answers. In fact, you should submit incorrect answers and use the hints to see what happens!

Part A

How many squares are in this 2×2 grid ([Part A figure](#)) ? Note that the figure link lets you know that a figure goes along with this part. This figure is available to the left.

Enter your answer as a number in the box below and then submit your answer by clicking Submit.

Number of squares =

[submit](#) [my answers](#) [give up](#) [review part](#)

Grading

See the help file available by clicking the **Help** tab in the top right corner, if you want to know more about how grading works. Here is the most important information you'll need.

e.g. Question

How to send an email....



Confused?

I don't understand your example.

How do I do the online homework?

What is 'homework'?

... email me!

How to send an email....

Dear Professor Tasker,

I am sorry, but I will be absent from 'Essential Physics I' on 9/5/2016.

This is because I have a doctor's appointment



How to send an email....

Dear Professor Tasker,

I am sorry, but I will be absent from 'Essential Physics I' on 9/5/2016.

This is because I have a doctor's appointment

I am on a trip for another class



How to send an email....

Dear Professor Tasker,

I am sorry, but I will be absent from 'Essential Physics I' on 9/5/2016.

This is because I have a doctor's appointment

I am on a trip for another class

My legs have been eaten by a dog



How to send an email....

Dear Professor Tasker,

I am sorry, but I will be absent from 'Essential Physics I' on 9/5/2016.

This is because I have a doctor's appointment.

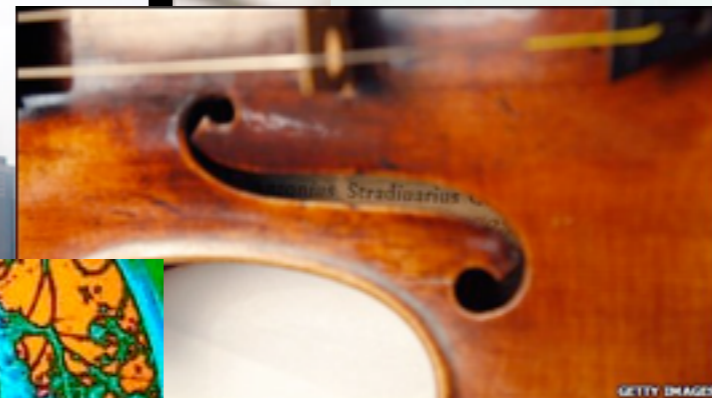
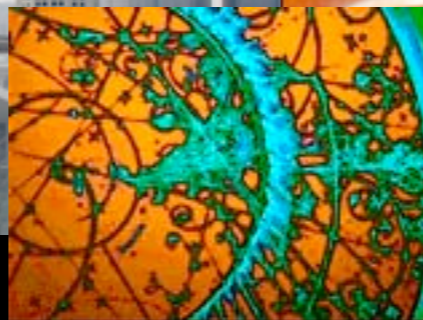
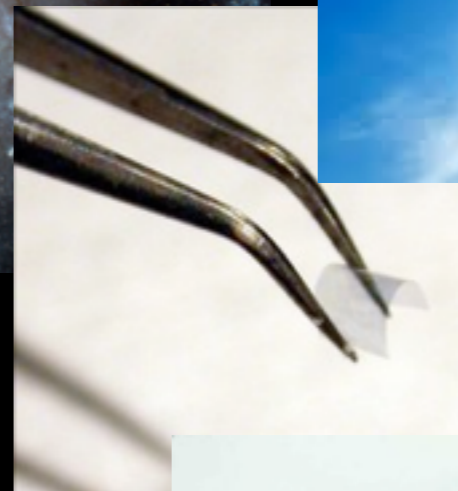
Thank you,

Kosuke Fujii

(student ID: 02153673)

Why study physics?

Physics aims to understand the universe



Why study physics?



$$KE = \frac{1}{2} I_{\text{cm}} \omega^2 + \frac{1}{2} M v_{\text{cm}}^2$$

$$\vec{v} = v_x \hat{i} + v_y \hat{j} + v_z \hat{k}$$

$$\vec{v}_{\text{relative}} = \vec{v}_{\text{Harry}} - \vec{v}_{\text{snitch}}$$

$$\vec{v}_x = \vec{v}_{x,0} + a_x t$$

$$\frac{1}{s} + \frac{1}{s'} = \frac{1}{f}$$

$$M = -\frac{s'}{s}$$

$$m_1 \vec{v}_{1,i} + m_2 \vec{v}_{2,i} = m_1 \vec{v}_{1,f} + m_2 \vec{v}_{2,f}$$

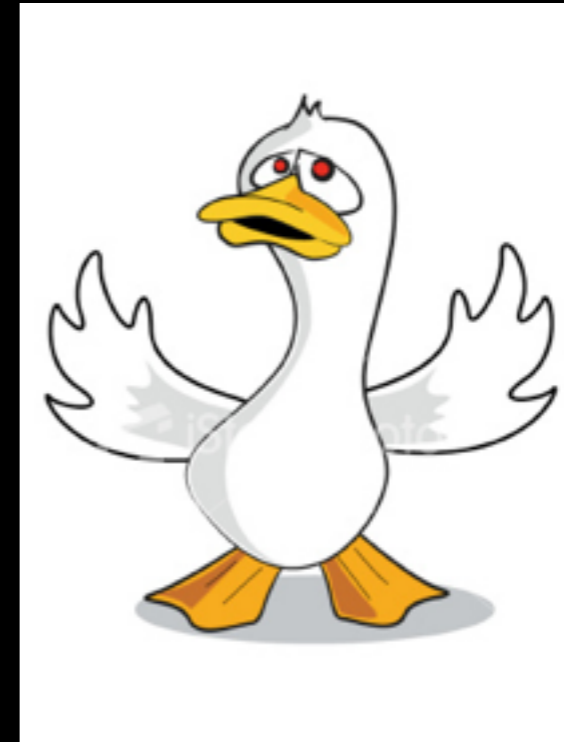
What will happen next?

Why study physics *in English*?

Physics is hard!



English is hard!



WHY would I study them together??



Why study physics *in English*?

Science is global



People need to work together, share ideas and knowledge all over the world.

Why study physics *in English?*

This needs a common language



If you are thinking of career in science:

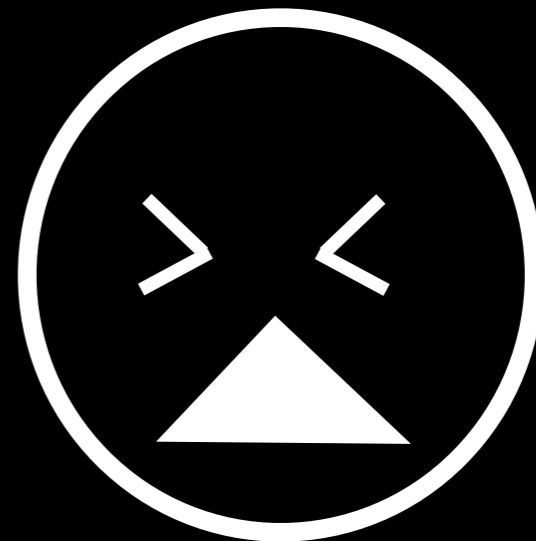
Practice English!

Lectures

Do I speak too fast?



OK!



Syllabus

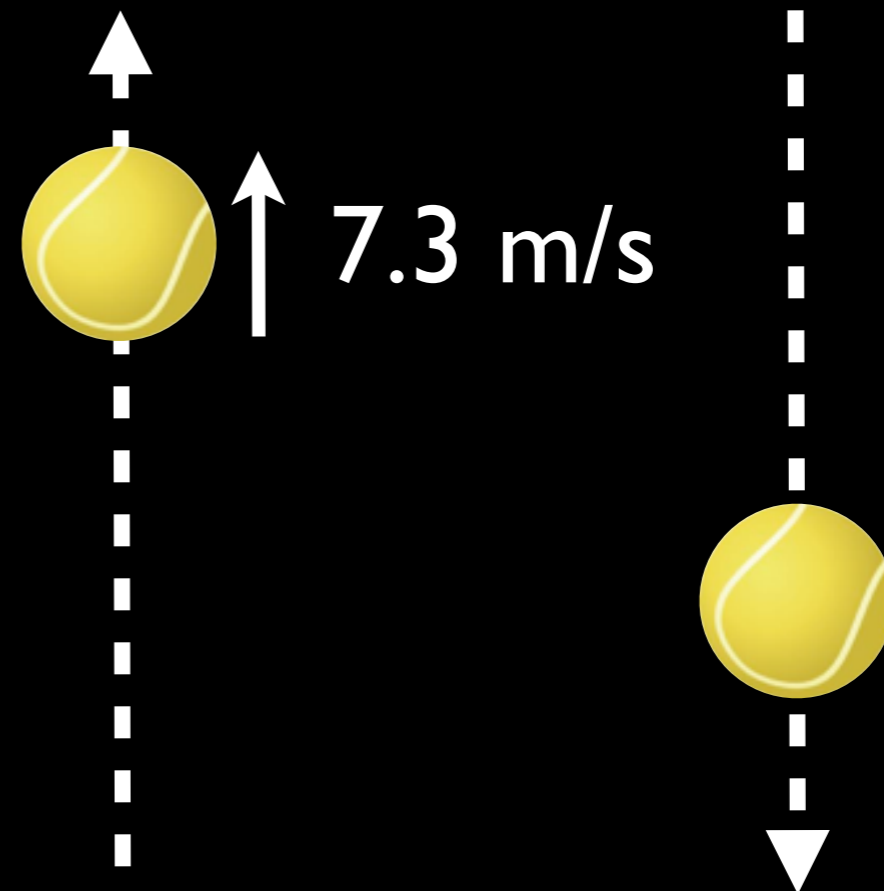
... examples from Prince of Tennis ...



Syllabus

Motion in a straight line

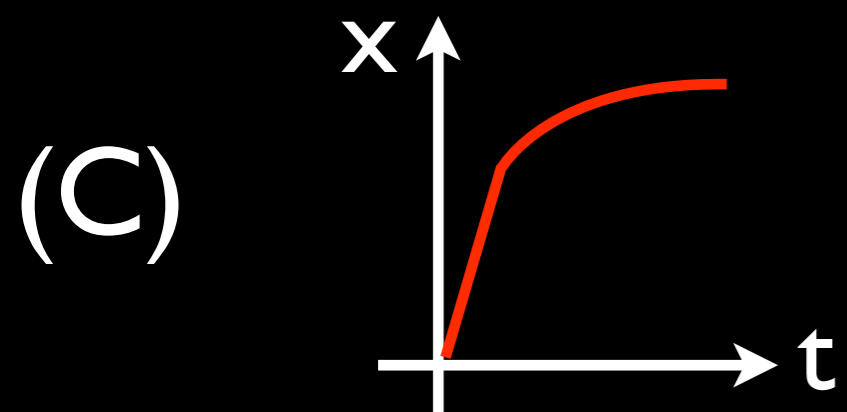
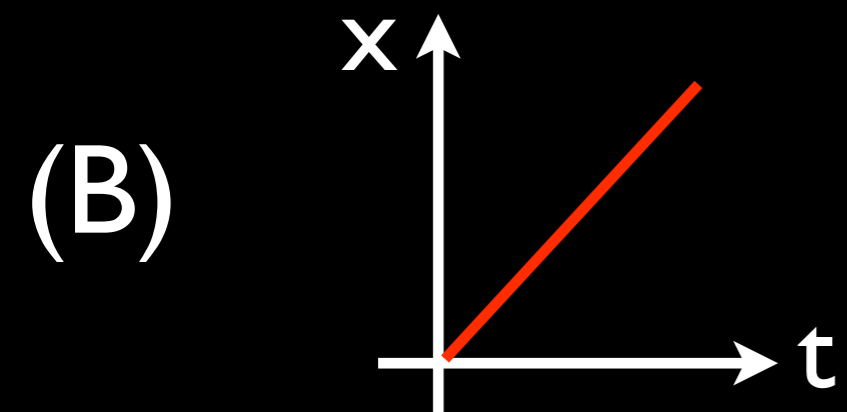
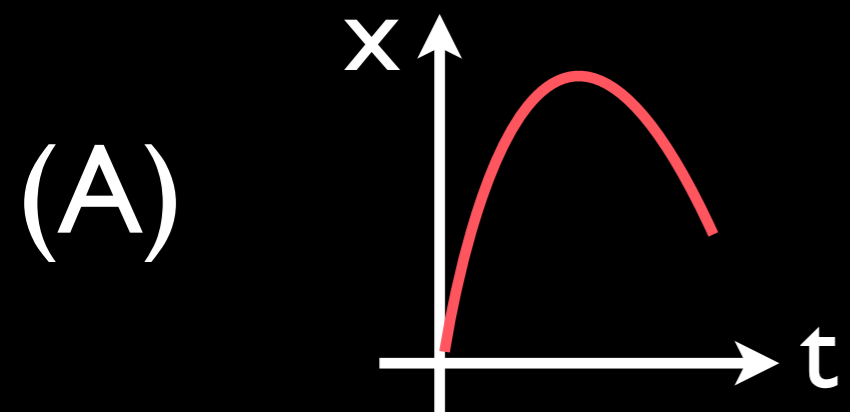
Dan throws a ball up to serve...



How much time does he have to hit it?

Syllabus

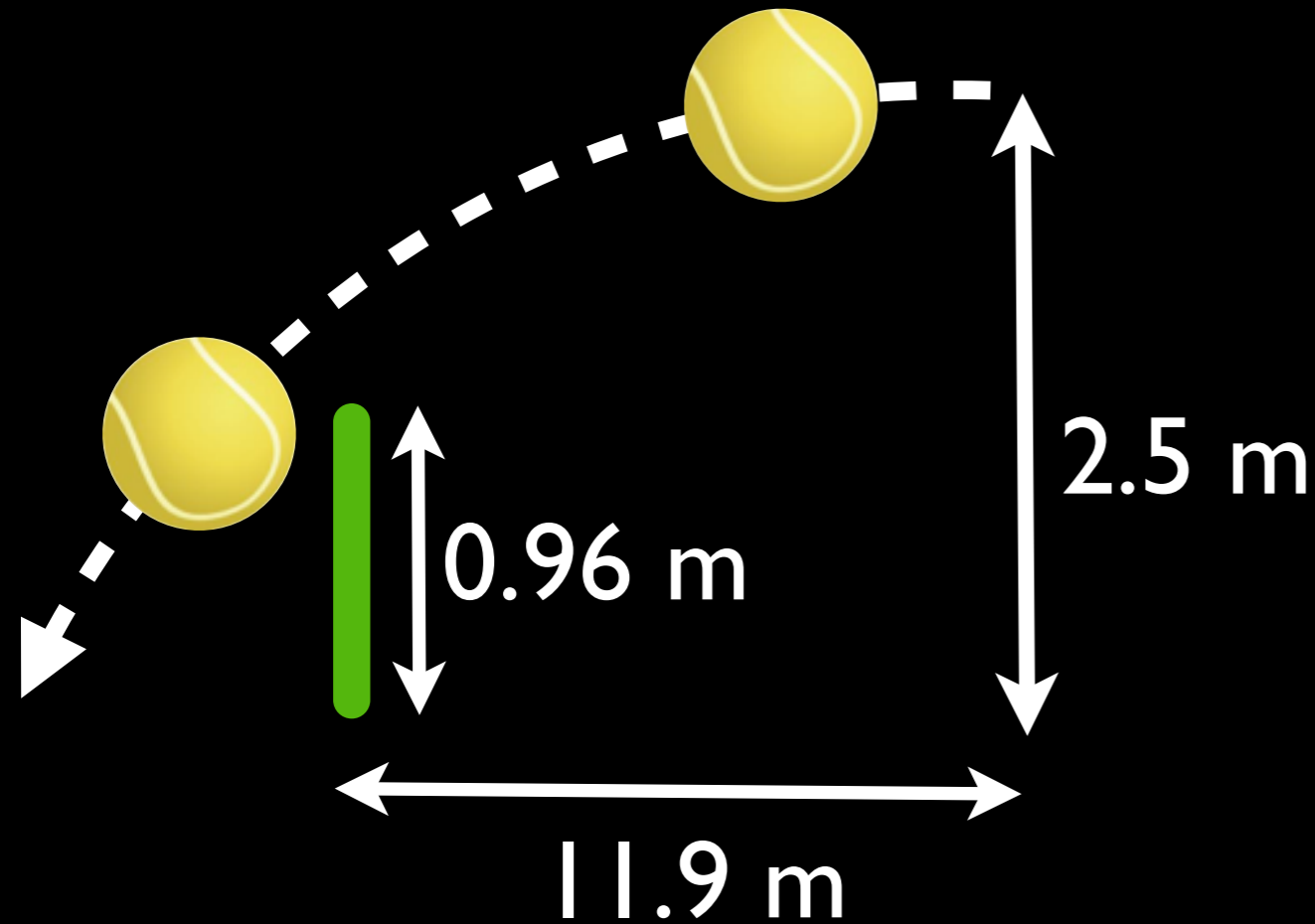
Motion in a straight line



Which shows an object changing direction?

Syllabus

Motion in 2 & 3D

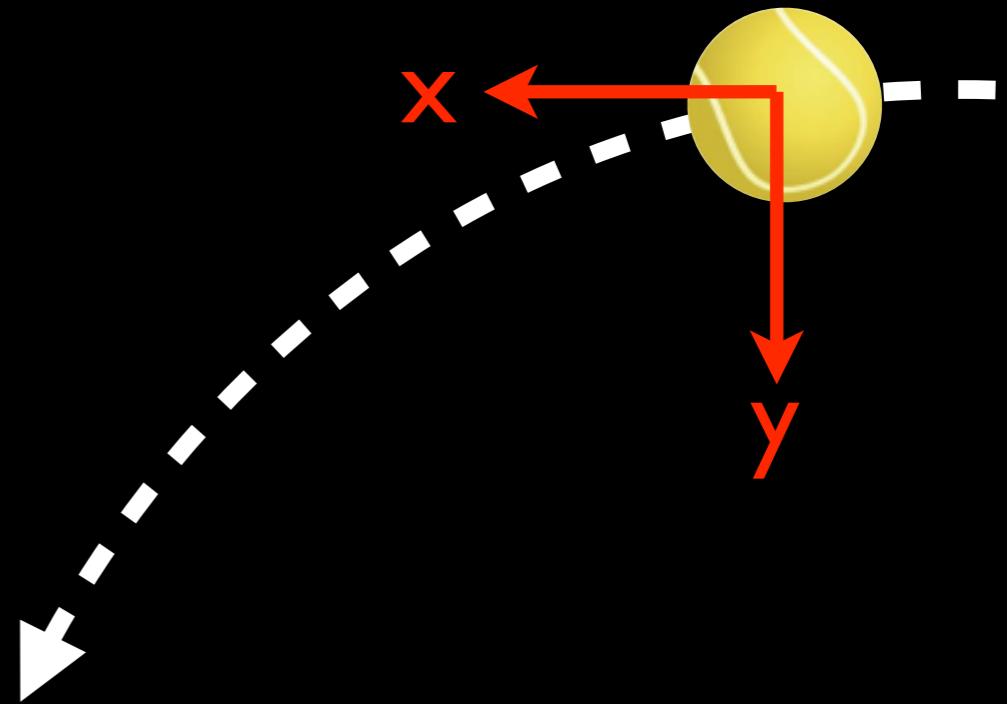


What speed must Momo hit the ball for it to pass over the net?

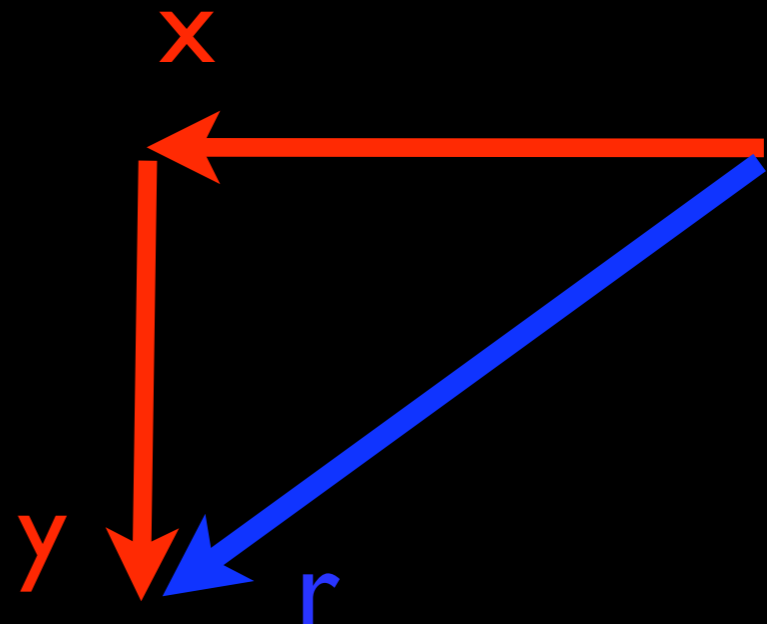
Syllabus

Motion in 2 & 3D

The **direction** of movement is now important



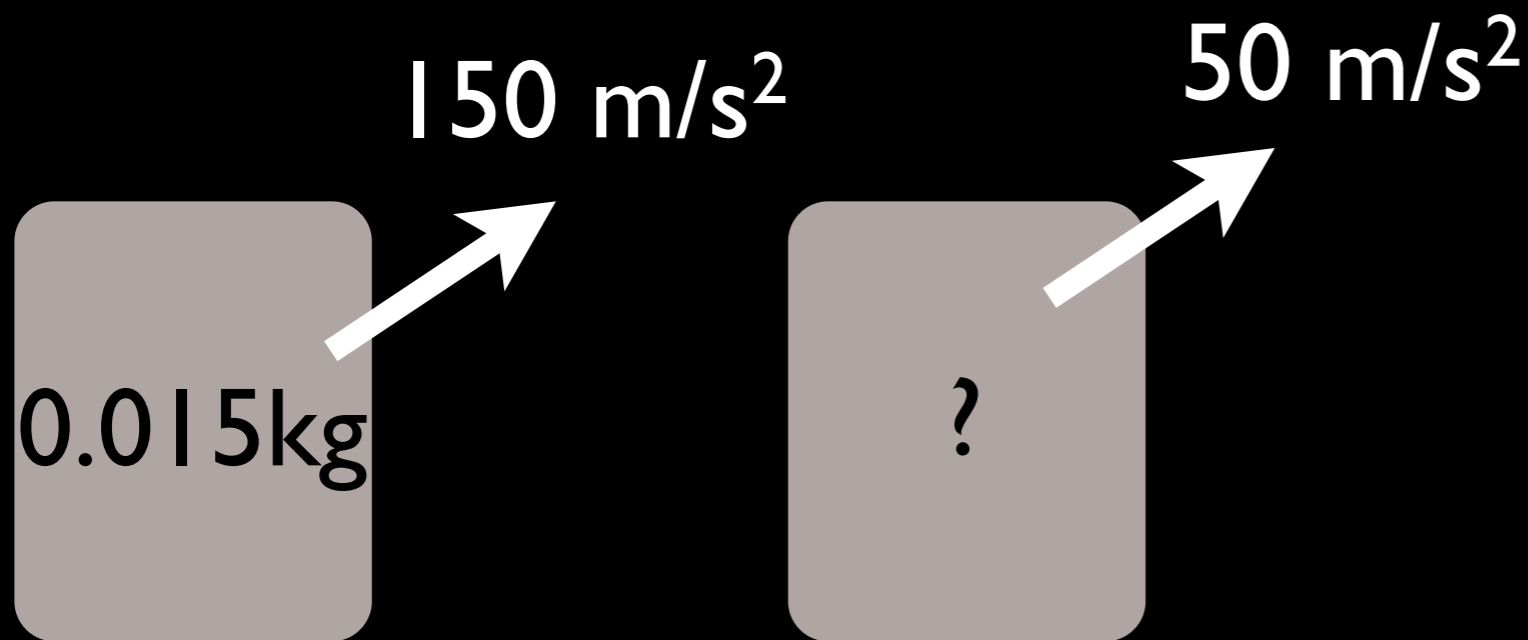
We use **vectors**, that have both magnitude and direction



Syllabus

Forces: changing the motion

A force produces an acceleration of 150 m/s^2



The same force gives a 2nd can an acceleration of 50 m/s^2 . What is the mass of the second can?

Syllabus

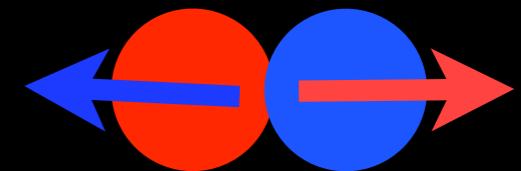
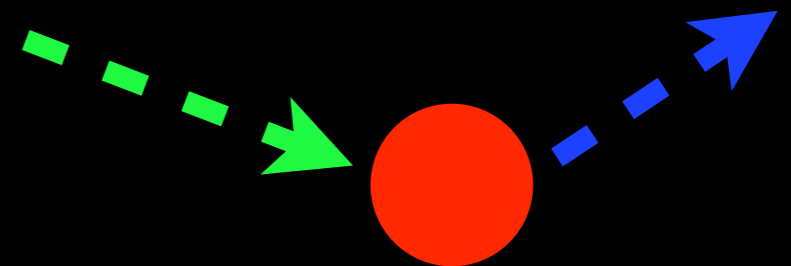
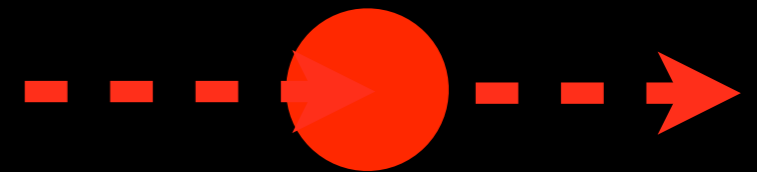
Forces: changing the motion

Newton's 3 laws of motion:

A moving object will remain moving unless acted upon by a net force

$$F = m a$$

The force from "A" on "B" =
The force from "B" on "A"



Syllabus

Energy: forces that change

$F = m a$ but what if

$F \neq \text{constant} ?$

Cannot assume constant acceleration any more!

Instead, look at the **energy** used!



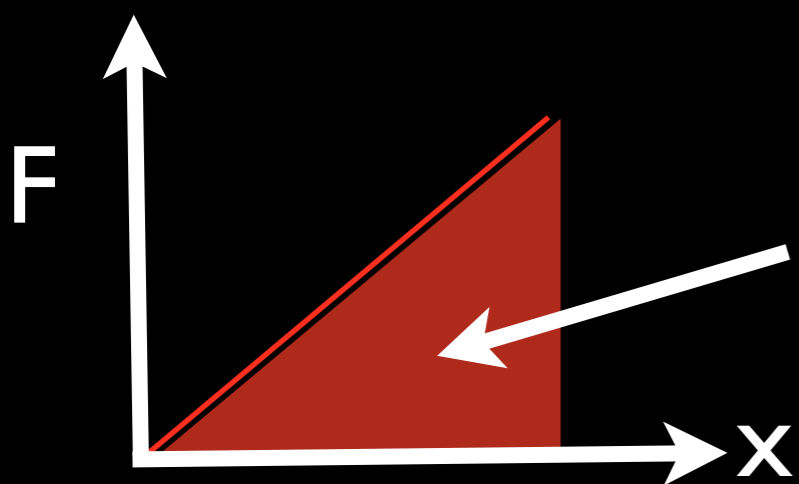
Could you push with a constant force?

Syllabus

Energy: forces that change

For an elastic:

$$F \propto x$$



energy

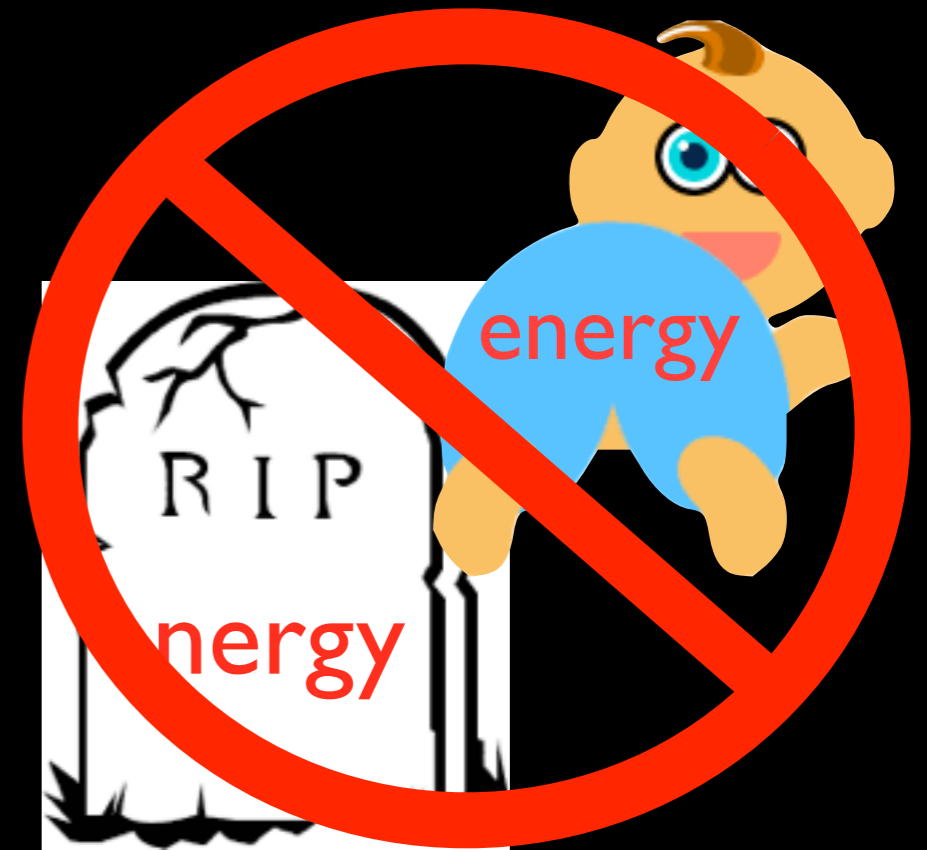
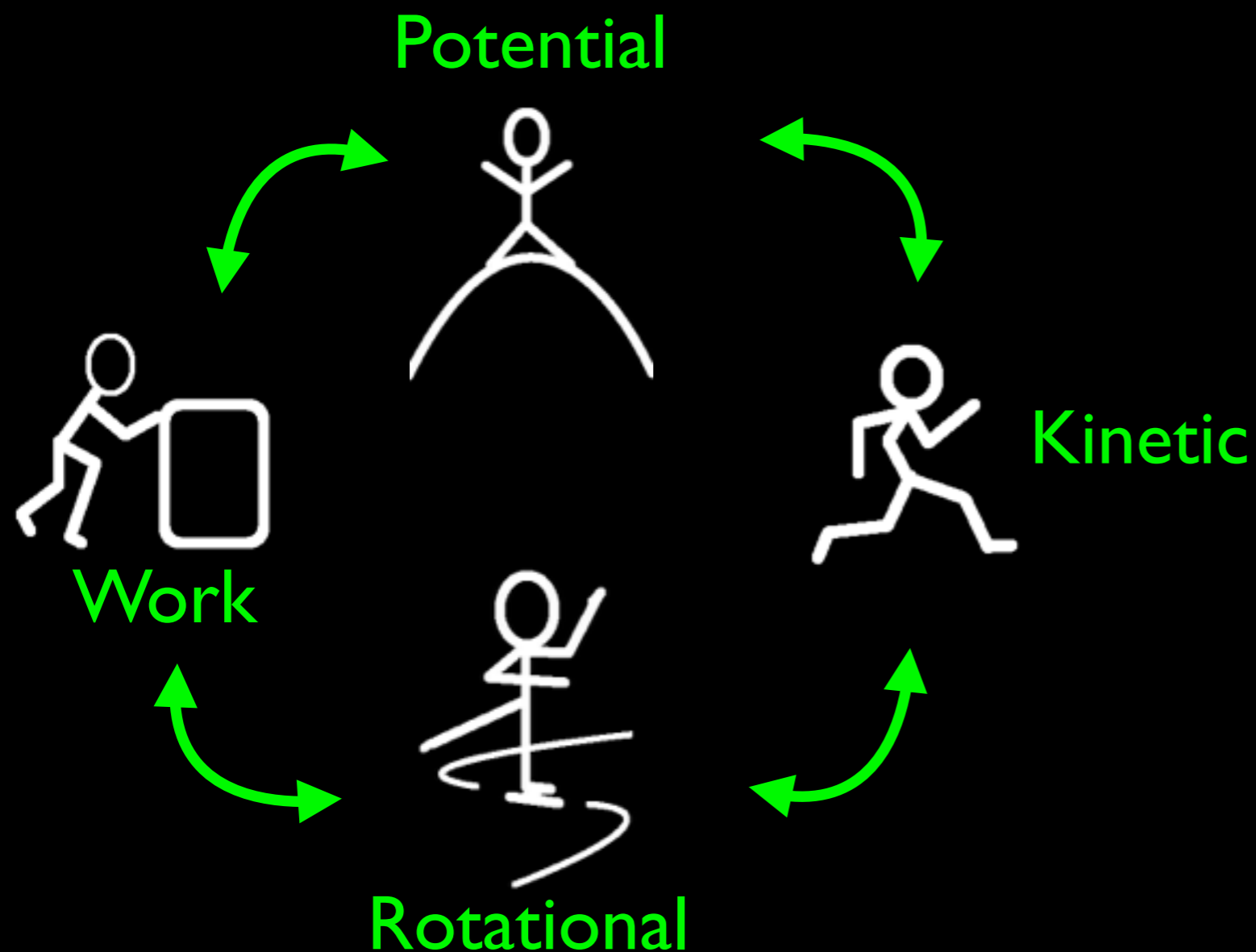


If the elastic needs to double in length to hit Sengoku, what work must we do?

Syllabus

Conservation of energy

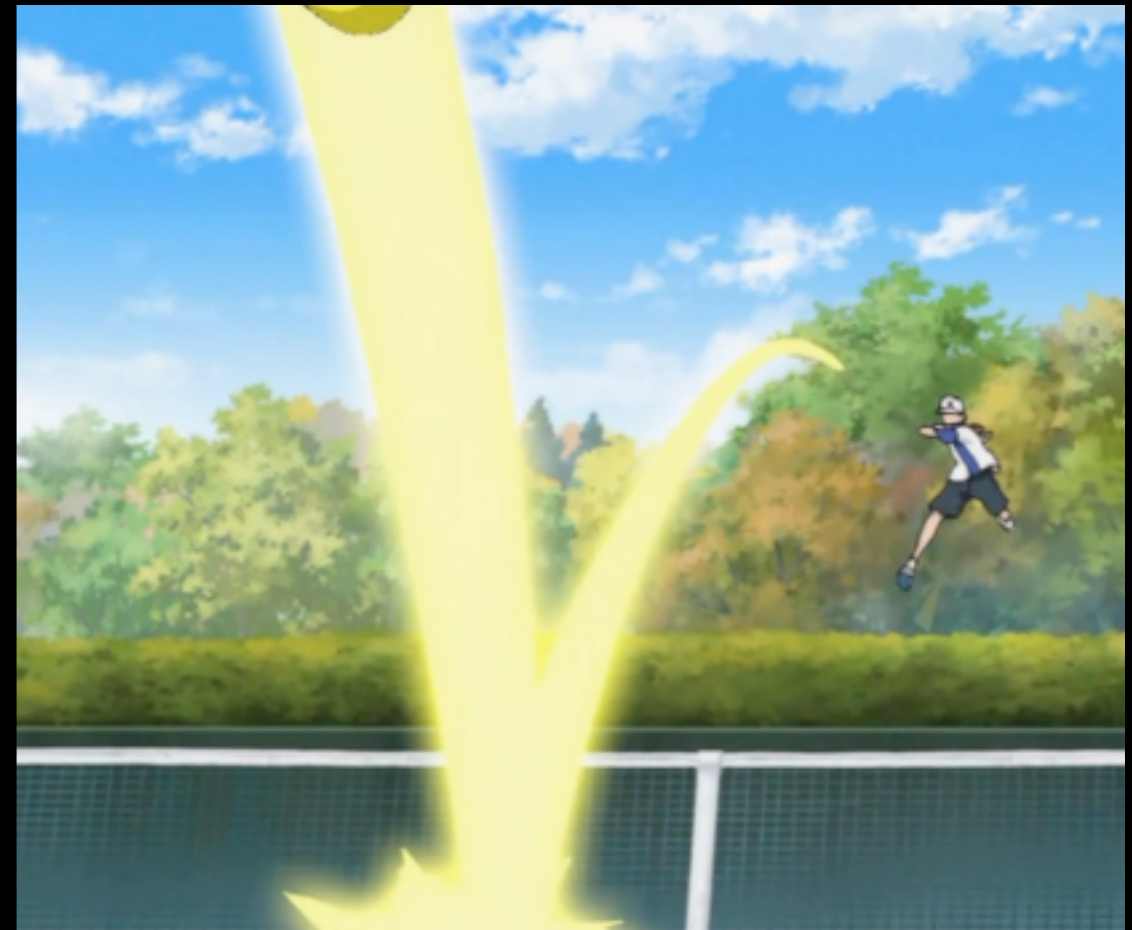
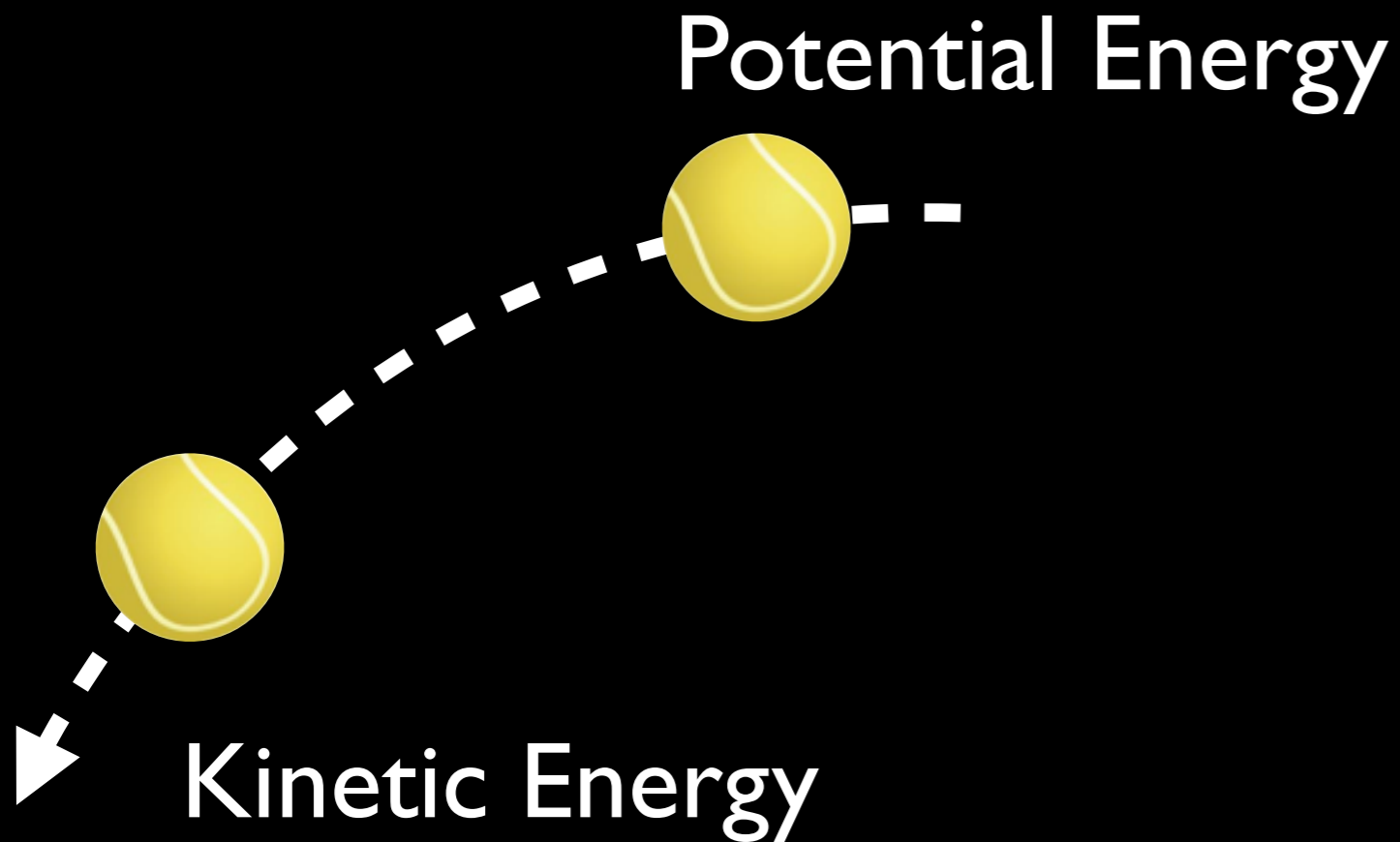
Energy cannot be created or destroyed



It can only change form

Syllabus

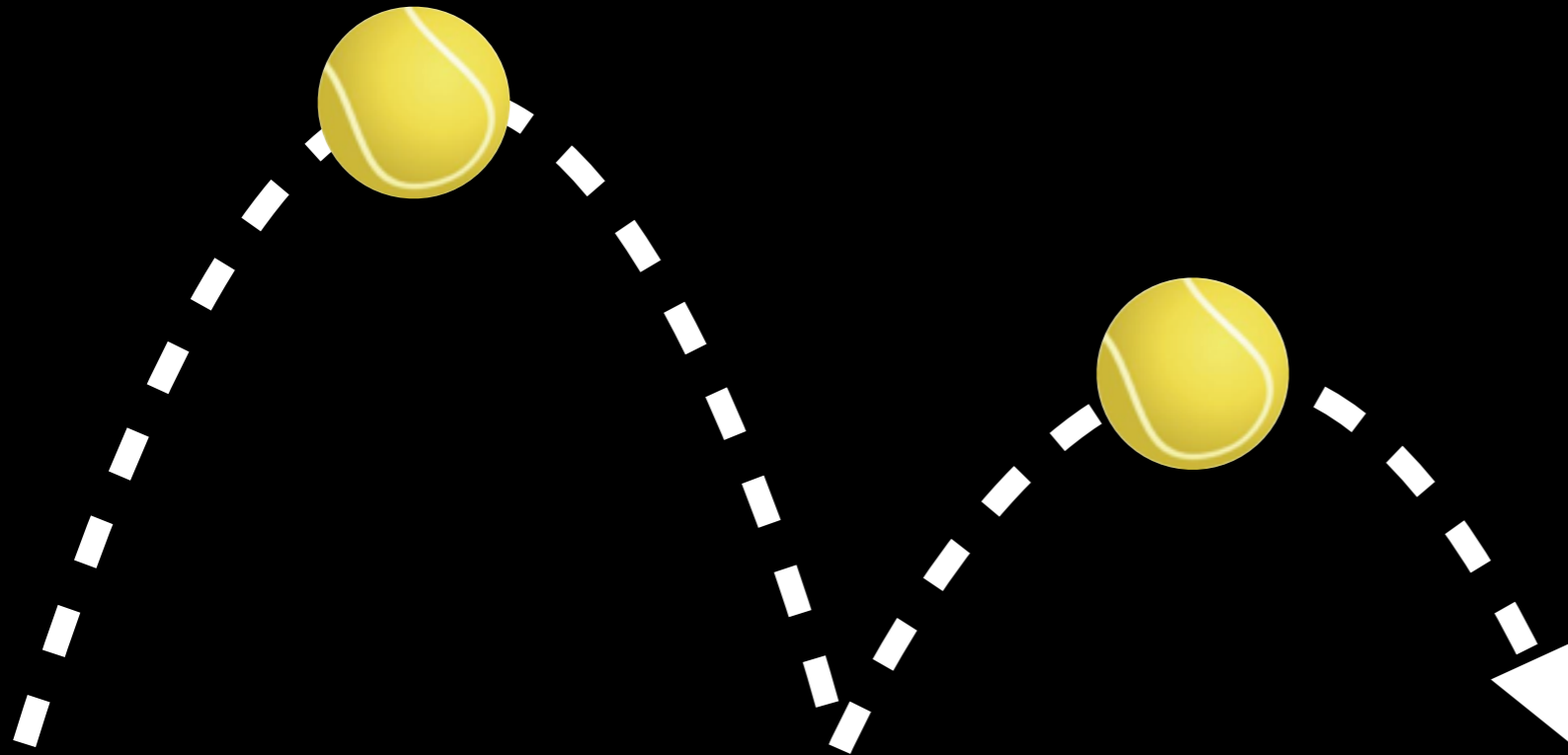
Conservation of energy



What is the speed of the ball just before it hits the ground?

Syllabus

Conservation of energy



Why doesn't a ball bounce as high on the 2nd bounce?

(A) energy is destroyed

(B) energy is changed into another form

(C) the ball bounces to the same height

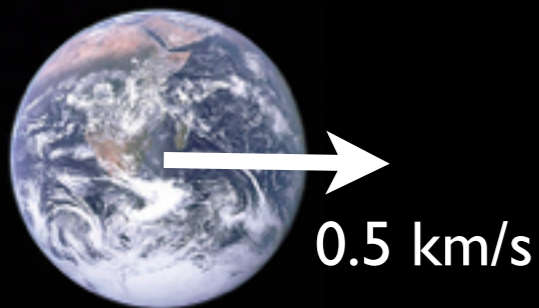
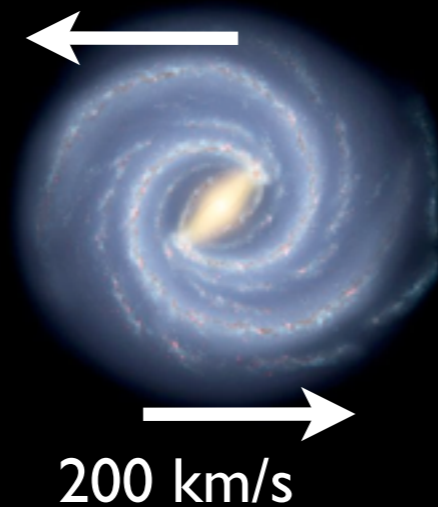
(D) another force prevents it

Syllabus

Rotation: a different motion

So many things rotate

Our Galaxy's
circular velocity
is 200 km/s!



At the equator,
the Earth rotates
at 0.5 km/s



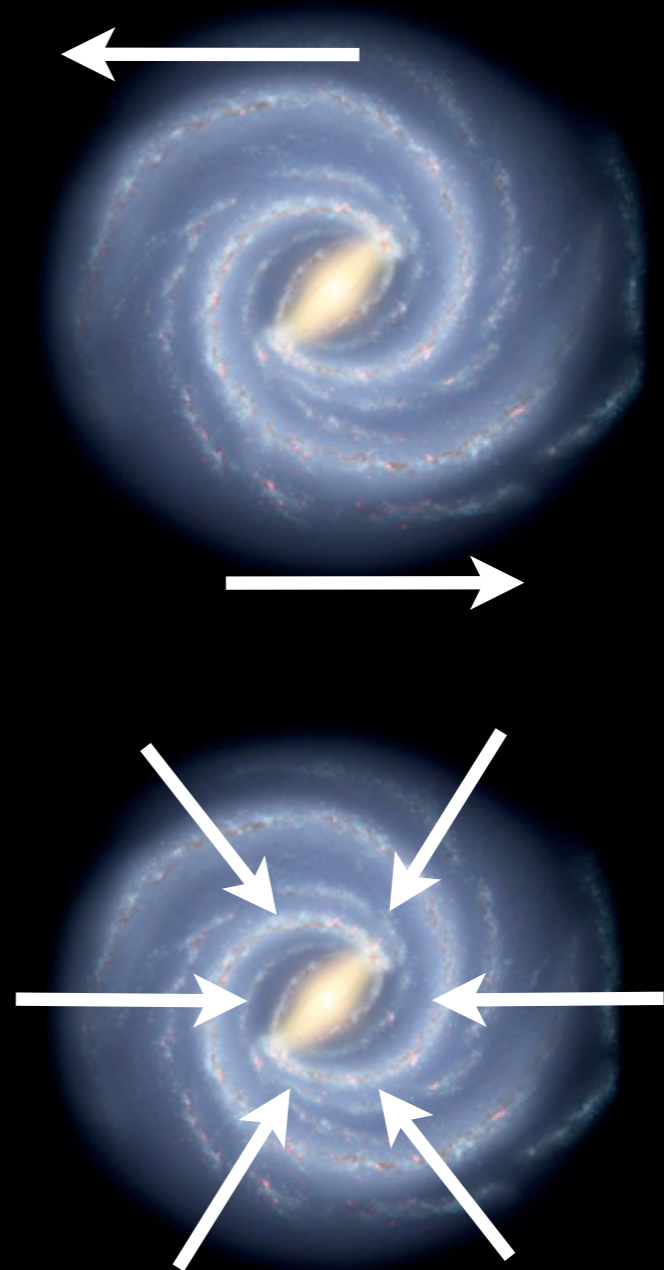
Syllabus

Rotation: a different motion

If the circular velocity is constant, can we use the equations of constant linear (in a line) acceleration?

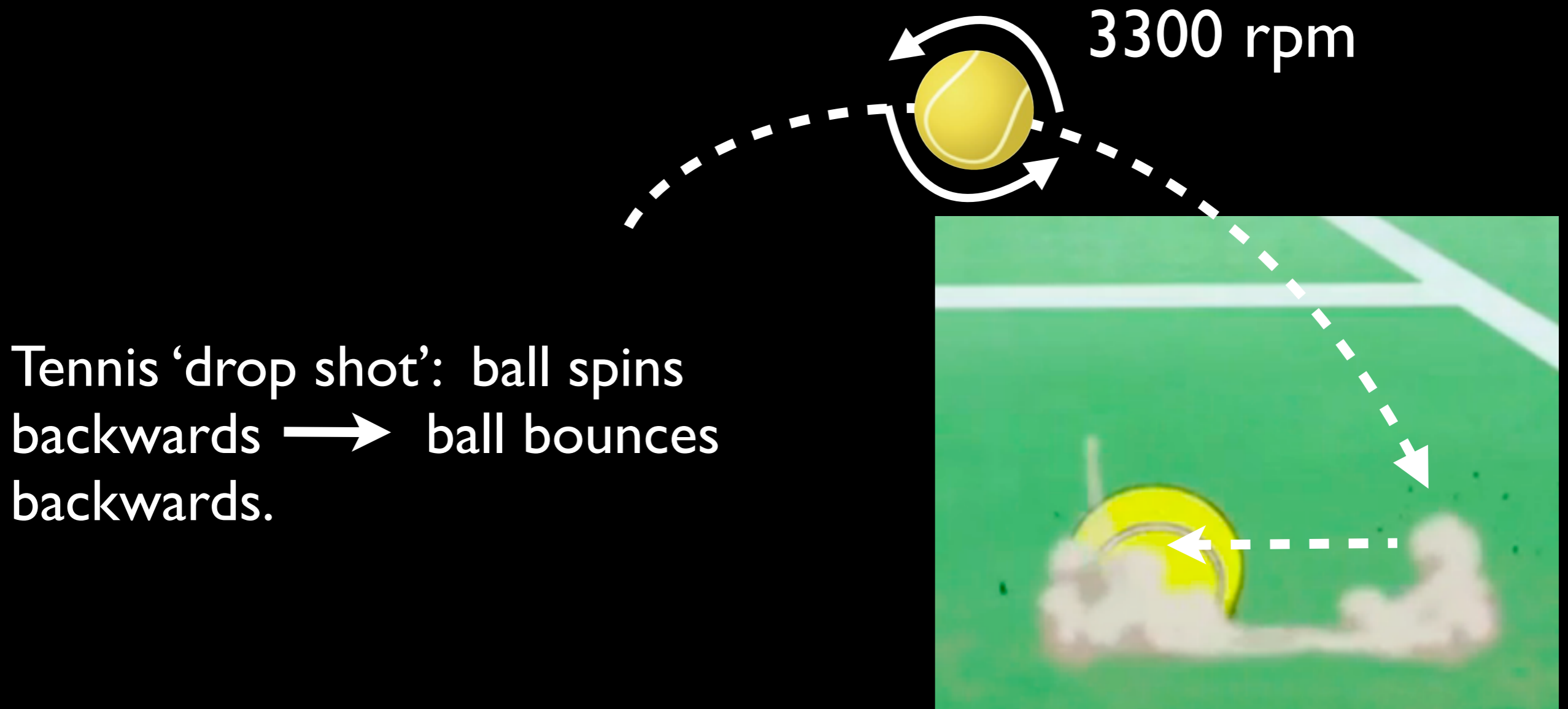
No! Because acceleration is a vector and its **direction changes**

Need new equations for rotation!



Syllabus

Rotation: a different motion



Tennis 'drop shot': ball spins backwards \longrightarrow ball bounces backwards.

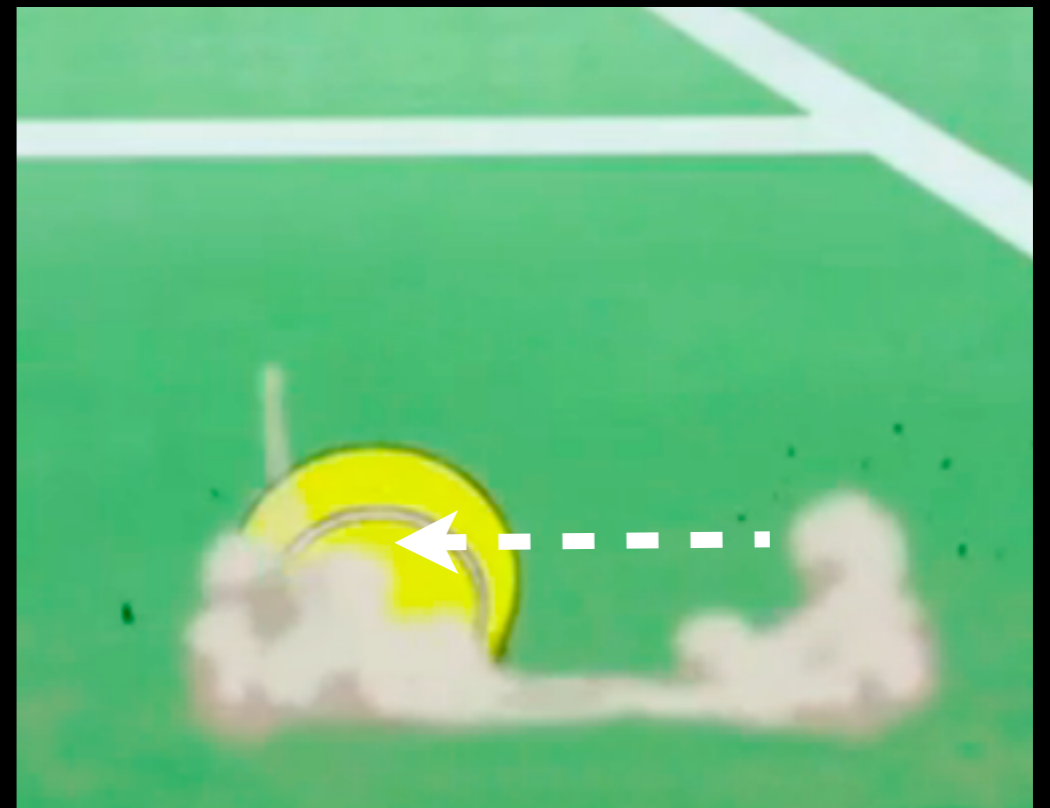
How many times does the ball rotate before it hits the ground, $1/3$ second later?

Syllabus

Rolling: rotational & translational motion

When a ball rolls, it has both rotational (↻) and translational (←) motion

Energy = Kinetic + Rotational



Does this slow the ball down or speed it up?

Syllabus

Equilibrium: balancing forces

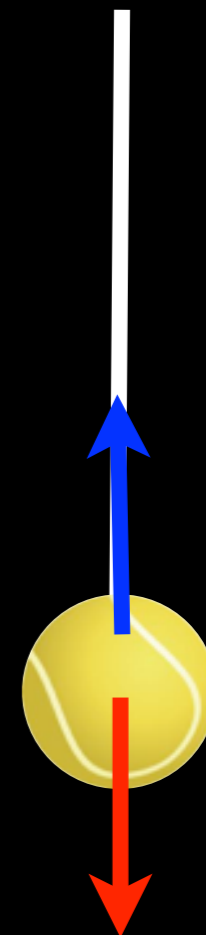
If all forces balance, then we are in **equilibrium**

$$F_1 + F_2 + F_3 + \dots = 0$$

A “**stable equilibrium**” returns to its position if it is pushed.



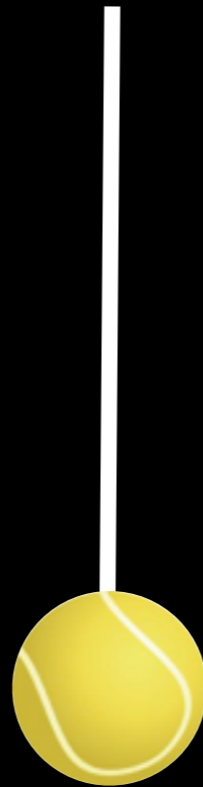
An “**unstable equilibrium**” does not



Syllabus

Oscillations

What happens when we push a stable equilibrium?

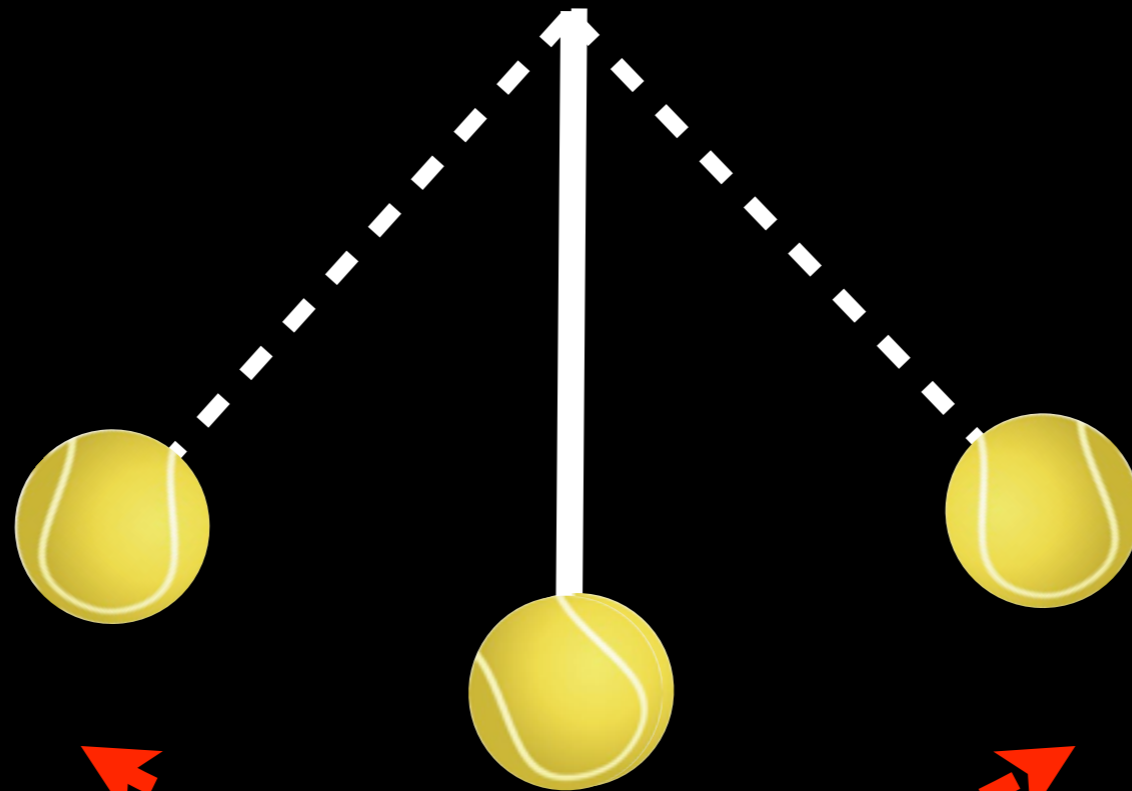


Syllabus

Oscillations

What happens when we push a stable equilibrium?

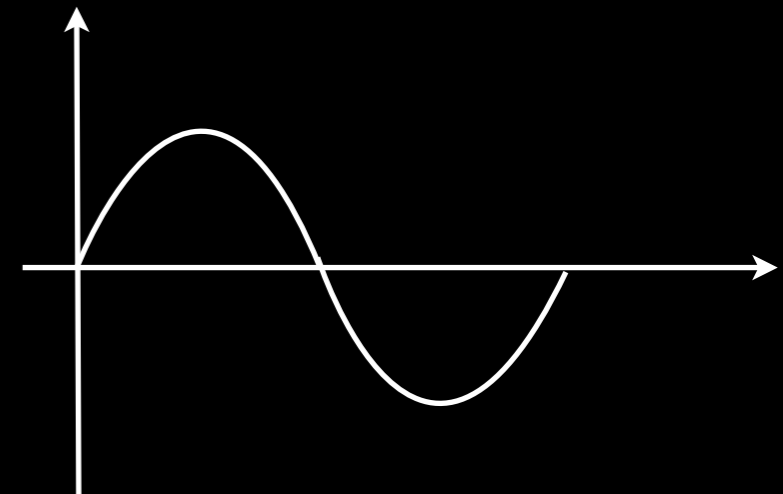
Forces push ball
back to the
equilibrium



Forces again
push it back

But, the ball
overshoots....

This motion is an **oscillation**

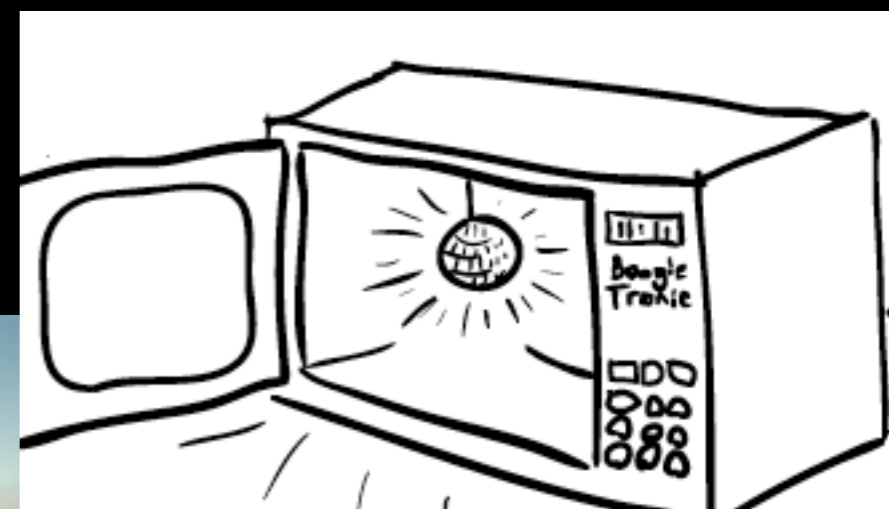
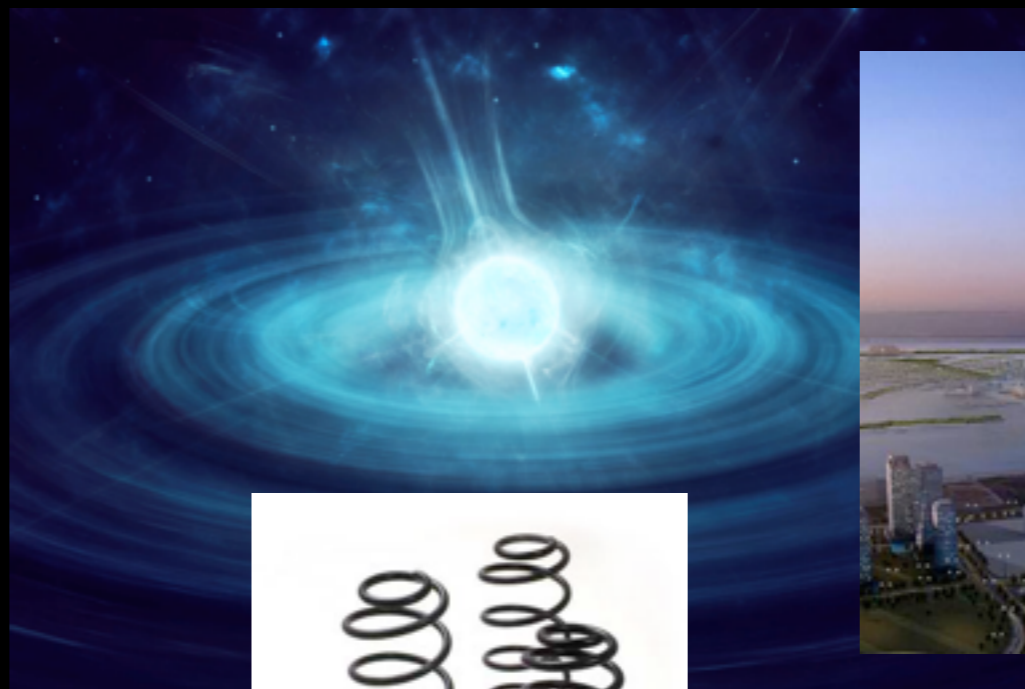


Syllabus

Oscillations

Many systems oscillate

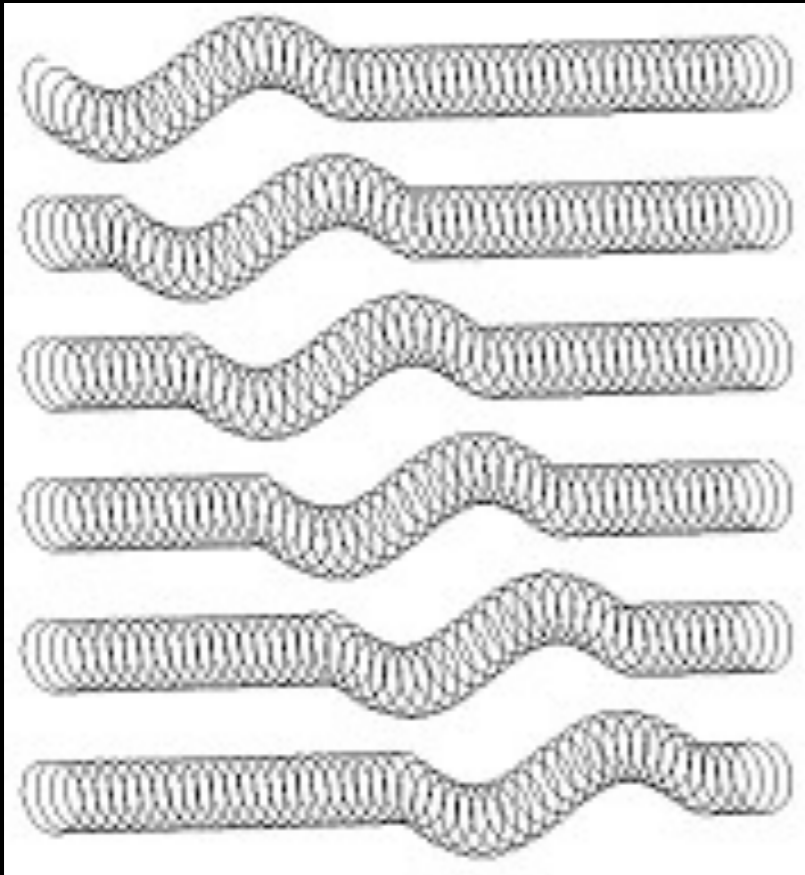
Finding the rate of oscillation allows safe bridges, hot food, the distance to stars...



Syllabus

Waves: moving oscillations

Travelling oscillations are waves



The metal does not move, but information about the wave does.

Waves transmit information

Syllabus

Waves: moving oscillations

Eyes closed, Echizen could hear the ball



Sound waves compress the air in a **longitudinal wave**.

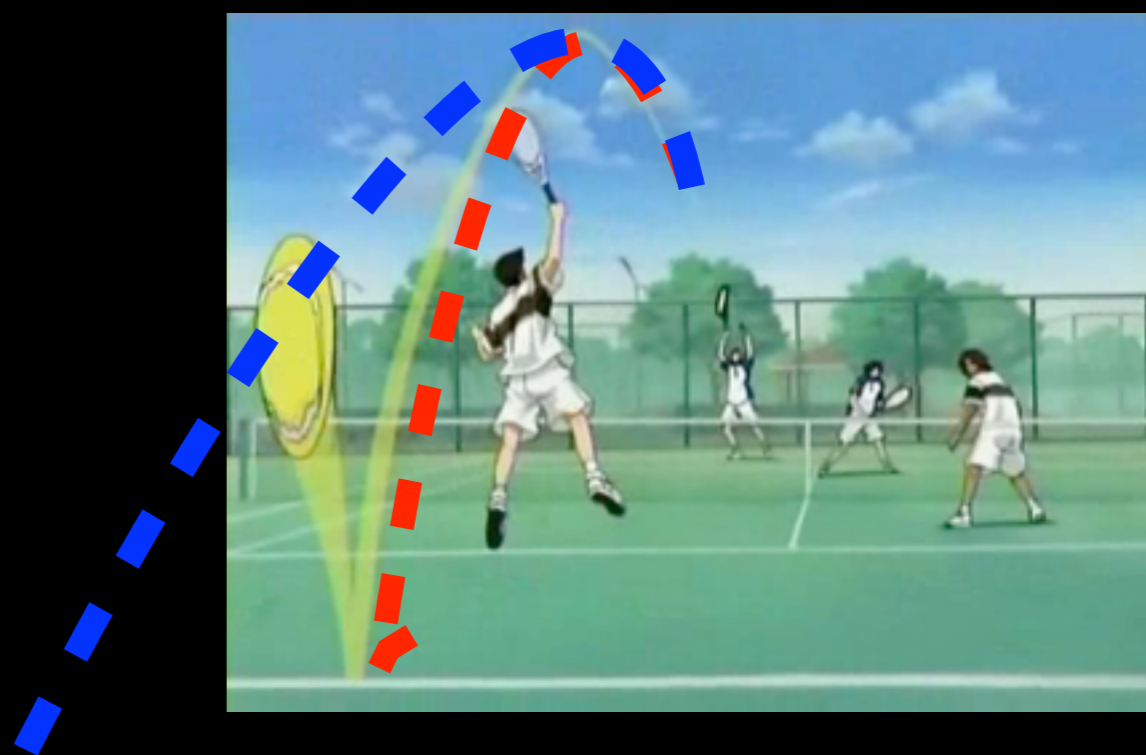
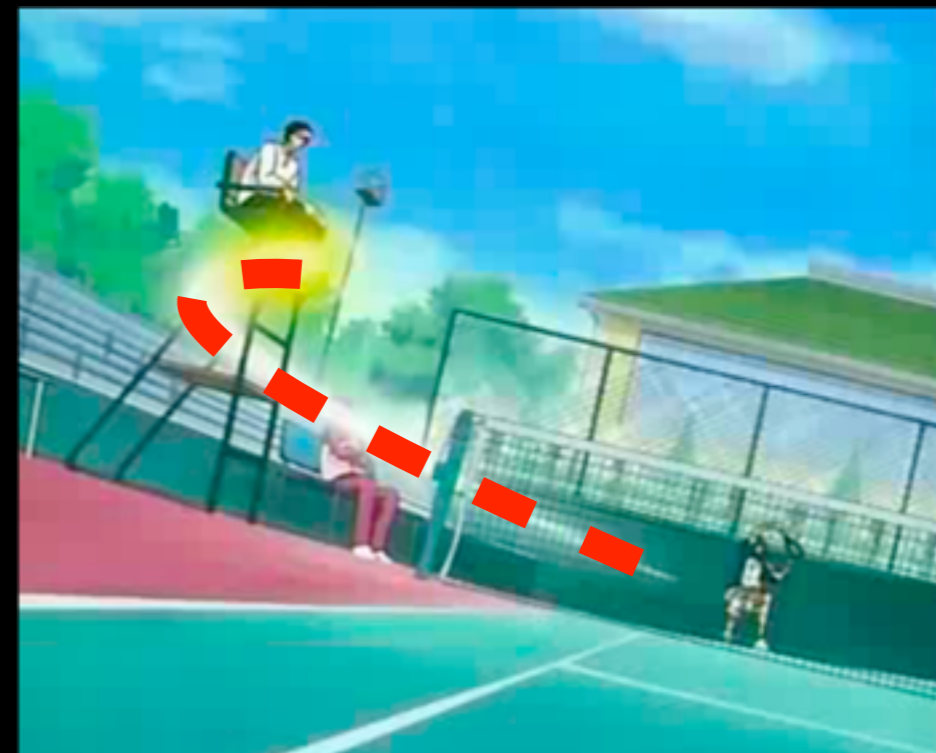
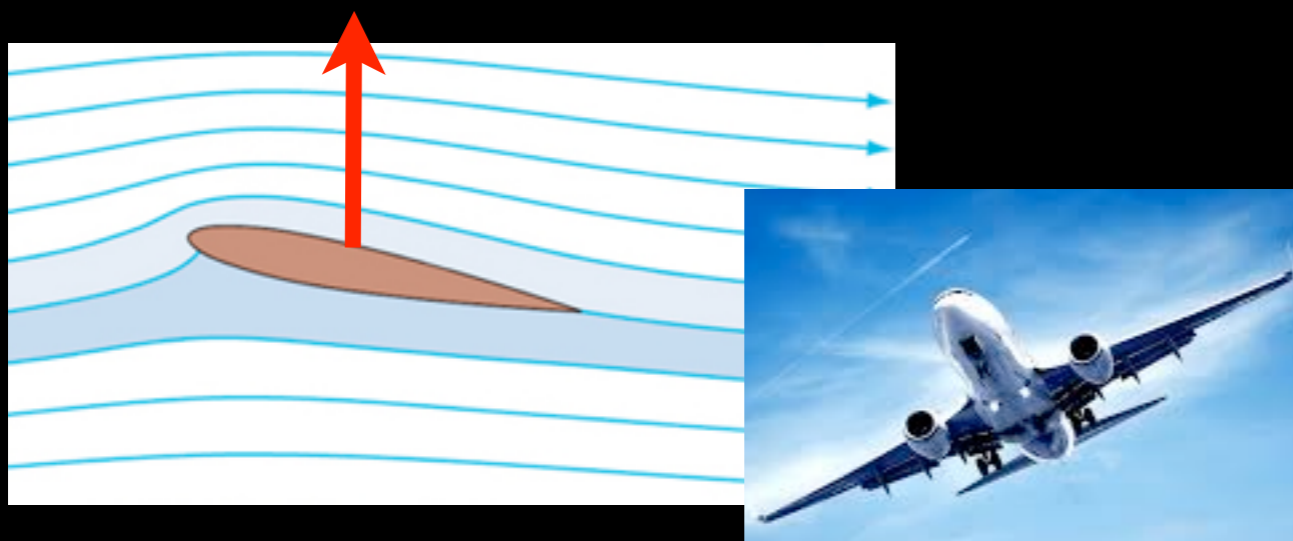
Syllabus

Fluids: moving in a medium

Why does the ball curve?

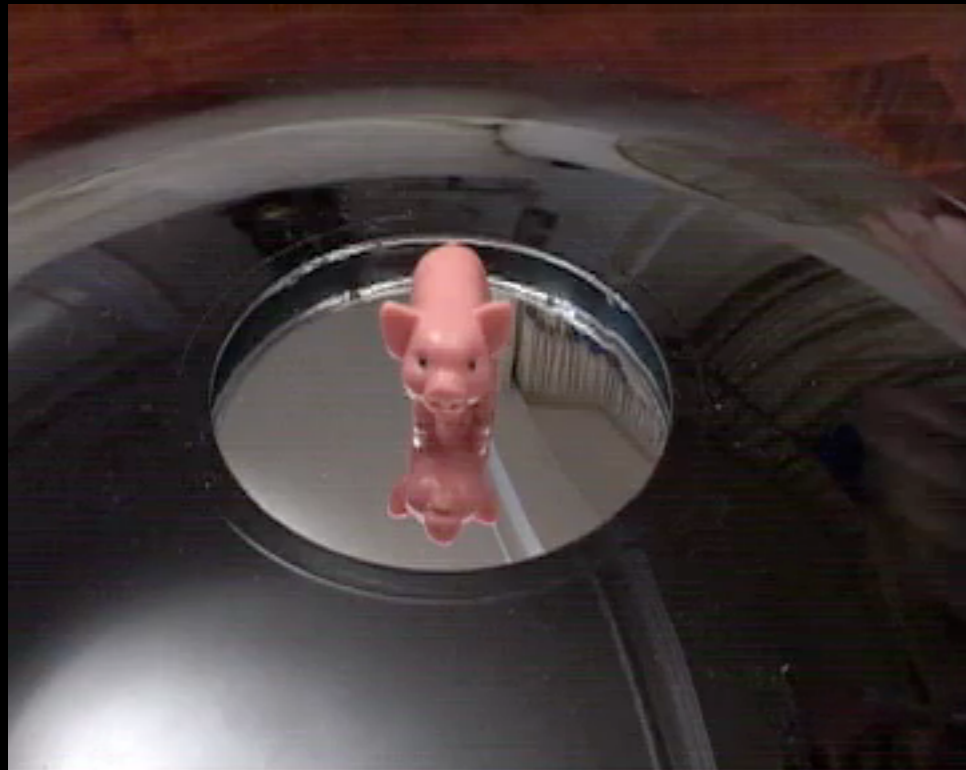
The ball's spin changes the pressure on one side, pushing the ball inwards

This also lifts an aeroplane's wing



Syllabus

Optics

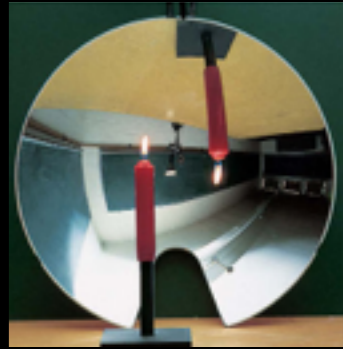


Reflections:

What size is the image?

Where is the image?

Is the image even real?



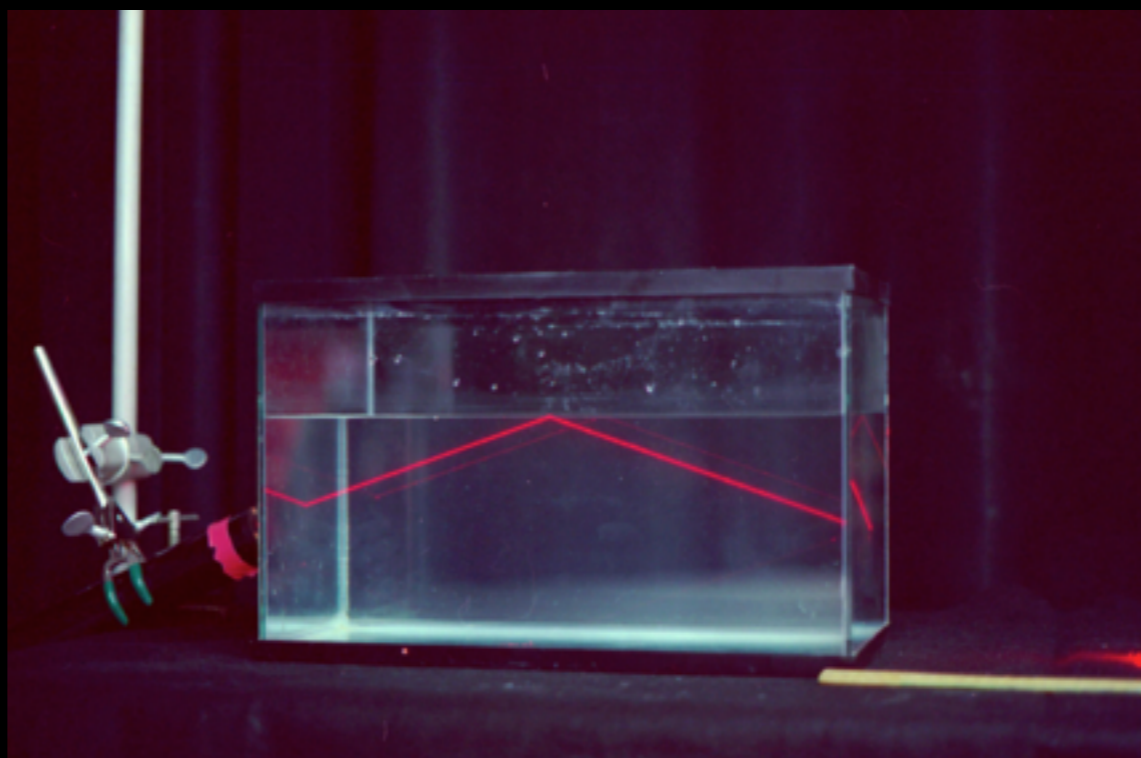
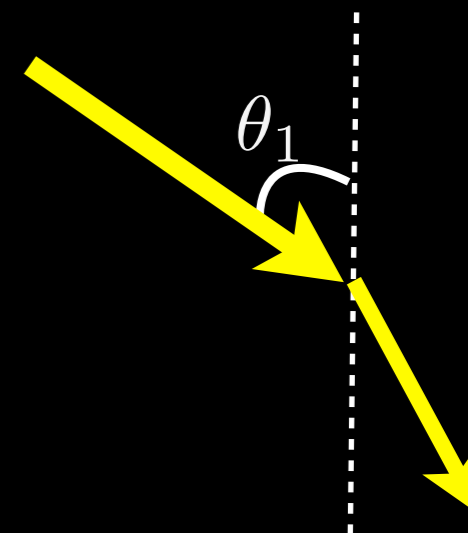
Syllabus

Optics

Refractions: light bending

Why does light bend?

How much does light bend?



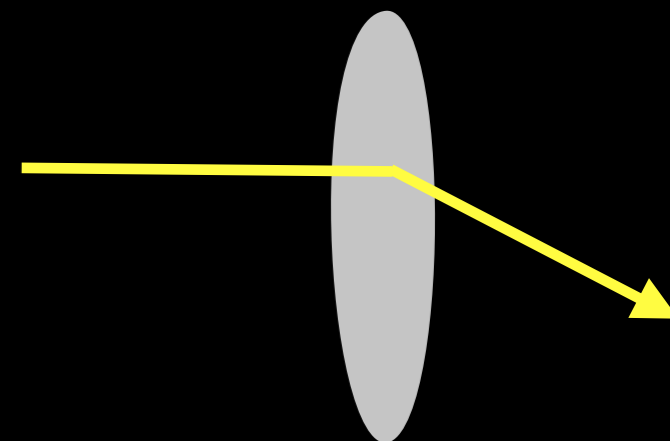
Syllabus

Optics



Lenses & Mirrors

Where does a lens focus?



Why do objects look closer in mirrors than they are?

Syllabus

Optics



Interference & Diffraction:

When waves hit an object

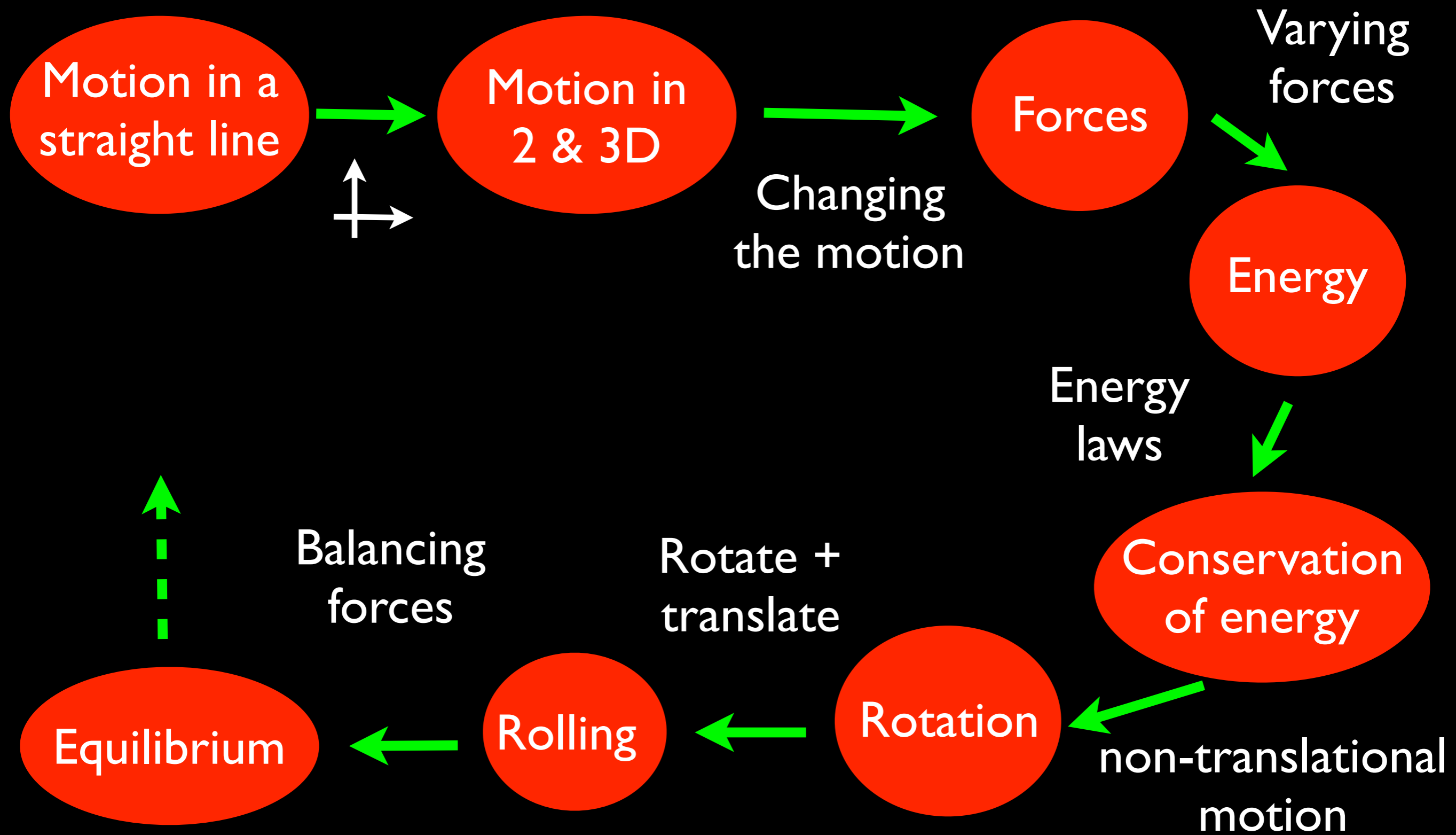


How do light waves mix?

Where do the light and dark areas occur?

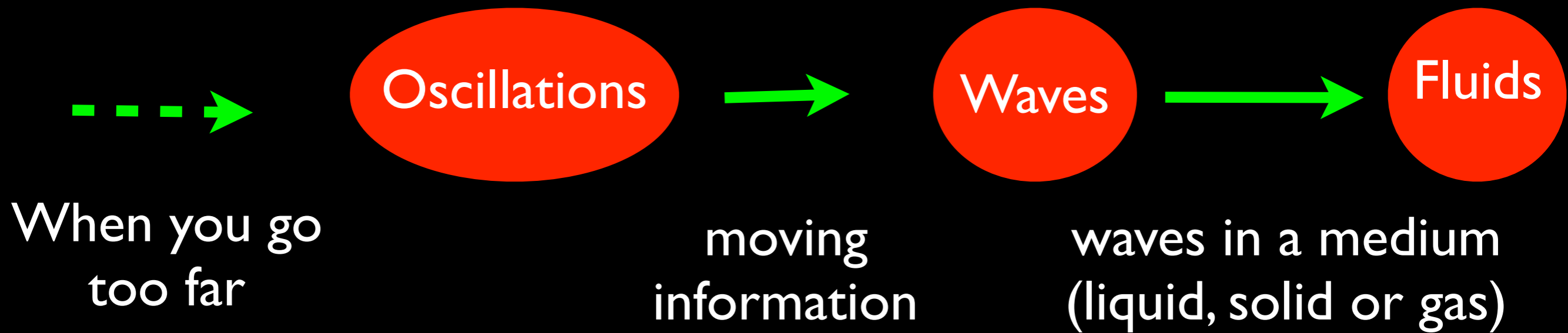
Syllabus

Part I: Mechanics



Syllabus

Part II: Waves



Part III: Optics

